ULTRASONIC WELDING PROCESS AND EQUIPMENT FOR CONSTRUCTION OF ELECTRON-TUBE MOUNTS

Weld Evaluation Report
Metallurgical Examination of Welds on Finished Tubes

June 1966

Contract No. DA-36-039-sc86741
Order No. 19063-PP-62-81-H

Placed by
Industrial Engineering Division
United States Army Electronics Command
225 South Eighteenth Street
Philadelphia, Pennsylvania

AEROPROJECTS INCORPORATED
West Chester, Pennsylvania

ULTRASONIC WELDING PROCESS AND EQUIPMENT FOR CONSTRUCTION OF ELECTRON-TUBE MOUNTS

Weld Evaluation Report
Metallurgical Examination of Welds on Finished Tubes

The objective of this program was to design and construct prototype welding equipment and associated accessories to perform by ultrasonic techniques some of the major critical welding operations required in the assembly of electron tubes. p. iii

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Specifications SCS-114A, ECIPPR-15
and MIL-E-1/1121A

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Report Approved by: J. Byron Jones

ABSTRACT

The sample lot of 100 Type 6080WB electron tubes, fabricated as the end-product of this program, was subjected to heater-cycling, shock, fatigue, 2000-hour life, stability and survival, and electrical acceptance tests. After testing, tubes were examined physically and metallographically to determine cause of failure. Of the 35 failures, 7 rejects were attributable to weld defects. Failures due to inadequacies in this first effort with ultrasonic welding tooling can be minimized or eliminated through further optimization of the special tooling beyond that provided for under the scope of this program. These results demonstrate the potential capability of the ultrasonic welding process in electron-tube manufacture.

See previous reports under contract DA-36-039-sc86741 for materials welded in making experimental electron tubes. End

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I. INTRODUCTION

The application of ultrasonic welding to the construction of electron tube mounts has been demonstrated with success. This accomplishment, in an area where ultrasonic welding equipment and techniques had never been previously applied, must be regarded as a pioneering effort. As could be expected, the tooling and the level of precision in assembly of tube components could not rival the standard manufacturing technology, which has been developed over a period of thirty or more years. Indeed, shortcomings in the performance of several completed tubes have been traced directly to straightforward errors in assembly, such as positioning. The causes of the defects found in a sample lot of 100 electron tubes during qualification tests have been sought by electrical measurements and by physical and metallurgical examination, to obtain information which would lead to improved assembly procedures for production manufacturing in the future.

A. Electron Tube Type 6080WB

The electron tube type selected by the U. S. Army Electronics Command for ultrasonic welding study was the 6080WB twin triode, which has a record of rejects and failures due to metallic spatter caused by conventional welding techniques and defective welded joints. In addition, the diversity of materials and joint geometries presented in this tube would be useful in considering conditions for ultrasonic welding of other electron tubes.

The investigations carried out to design and construct tooling and to establish techniques for accomplishing the required joints have been described in the quarterly progress reports and are not reviewed here. However, it is emphasized that no significant redesign of the 6080WB construction was undertaken and that components normally used in standard manufacture were used throughout the program. It became evident as the work proceeded that a change in the design of several components would simplify or eliminate various complex tooling problems which arose; however, such redesign was not contemplated within the scope of the program. Two modifications, however, were made during initial investigations: (1) elimination of the grid radiator and (2) a change in the geometry of the getter-to-snubber support joint. Consistent weld strength was not attained in joints made to the carbonized nickel grid radiator, and the radiator and intermediate ceramic spacer were eliminated from the tube since operation would not be affected thereby. The cross-wire weld geometry of the getter frame and snubber support rod resulted in intermittent damage to the components. By changing this joint to a parallel-wire geometry, strong consistent welds were obtained with no adverse effects on tube performance.

With these exceptions, all geometries evolved over the years for resistance-welding assembly of the 6080WB tube were employed in the ultrasonic welding fabrication. Since hardness of the metallic components is not closely controlled by vendors of such items and since ultrasonic welding is somewhat more sensitive to material hardness (temper) than resistance welding, several of the standard components required hydrogen annealing to insure uniformity and consistency of material properties.

B. Fabrication

Pilot production of the 6080WB electron tube mounts was performed with a "SONOWELD" Model W-600-TSR ultrasonic welder equipped with special welding tips and fixtures. The work was carried out by Tung-Sol Electric Incorporated at Bloomfield, New Jersey, with Aeroprojects personnel assisting. The assembly sequence, delineating the tip and anvil tooling required, is shown in Appendix A, Table A-I. The photographs in Appendix A illustrate the progressive construction of the tube mount and the welding tooling employed. (The numbers in the photographs refer to the assembly sequence numbers in Table A-I.)

II. TEST RESULTS AND METALLURGICAL EXAMINATION

The sample lot of 100 tubes was tested in accordance with the schedule presented in the Fourteenth Quarterly Progress Report (Table II, p. 5). All tests were performed in accordance with the applicable paragraphs of TSS MIL-E-1/1121 (9/9/60) and witnessed by Mr. S. Zucker, USAECOM, Production and Procurement Directorate, Fort Monmouth, New Jersey, or the USAECOM resident inspector at the Tung-Sol Bloomfield facility. Test results are summarized in Table I. Complete test data are presented in Appendix B.

Tubes which had been subjected to heater-cycling tests, shock tests, fatigue tests, and 2000-hour life tests were examined physically and metallographically to determine the reasons for failure. (There are no end-point requirements for the 2000-hour life test, only for 1000-hours under MIL-E-1/1121.) At least half the total number of satisfactory tubes from each test series were examined, together with at least half of those which failed the test requirements.

A. Heater-Cycling Test

All twenty 6080WB electron tubes subjected to heater cycling sucessfully met the end-point requirements. Physical examination of the heater-lead connection and heater connector/stem lead welds disclosed no indication of damage in these areas. A source of potential difficulty, which was realized in the shock and fatigue test groups (see Sections B and C), is the insufficient length of the stem leads (pins 7 and 8) which are welded to the heater connectors. It was documented in the quarterly progress reports that the lead wires of the glass stems required manual crimping, trimming, and bending into proper orientation to match the various connectors of the cage assembly. Although this is normally a precision machine operation, in the present case the required crimp in the stem lead made it impossible to use Tung-Sol's in-plant stem-lead-forming machine without modification of the bending and trimming dies. Forming and trimming the leads by hand introduced alignment errors in the stem-cage assembly. In the case of the heater leads, they had all been cut too short and a full area weld between the lead and the connector was not possible. Because the preparation of additional glass stems with crimped and correctly trimmed leads would have delayed schedules established for completion of the tube fabrication, the short leads were used. Figure 1 shows the geometry of the heater connector/stem lead weld. Only the bottom corner of the connector could be welded to the lead without undue distortion of the heater connectors.

A photomicrograph of the heater connector/stem lead joint is shown in Figure 2. The section was taken longitudinally (parallel to the stem lead

Table I

SUMMARY OF TEST RESULTS FOR
SAMPLE LOT OF 6080WB ELECTRON TUBES

Test	Tested	Rejects	Reasons for Rejections
Heater Cycling	20	0	
Shock	15	8	2 - broken welds (heater connector/stem lead) 5 - high Ep (plate voltage) values 2 - cracks in glass stem
Fatigue	20	19	5 - broken welds 2 - heater connector/stem lead 1 - top cathode connector/cathode sleeve 1 - snubber support rod/bottom cathode connector 1 - several; cage displaced 1 - high Ep before test; satisfactory after test 6 - high Ep before test 4 - high Ep after test 2 - cracks in glass envelope 4 - short circuit (grid lateral/cathode) 2 - high transconductance in Section 2
Life - 2000 hr*	20	7	2 - pins not soldered; failed before 1000 hrs 1 - short circuit (grid lateral/cathode) 2 - heater/cathode leakage 3 - high grid current
Stability and Survival Rate	15	0	
Electrical (Acceptance Inspection)	10	1	1 - high Ep in y position

* There are no end-point requirements specified for a 2000-hour test, only for a 1000-hour test. Only two tubes failed to meet these requirements at 1000 hours (and these two had unsoldered base pins).

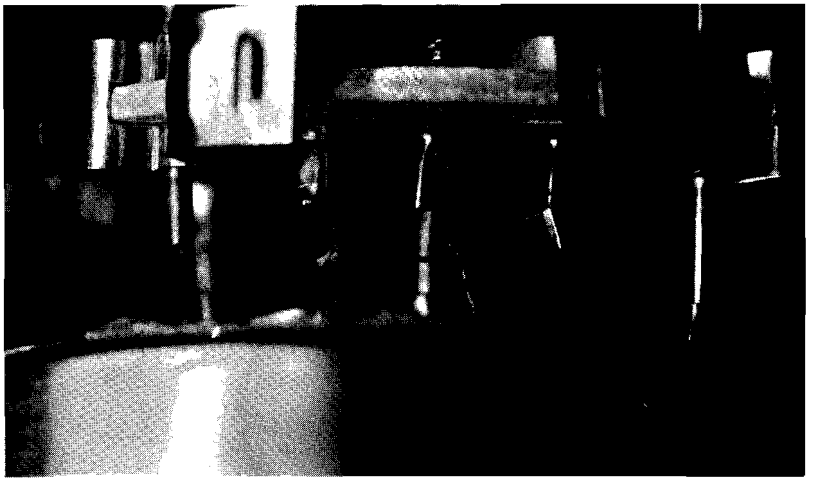


Figure 1

GEOMETRY OF WELD BETWEEN HEATER CONNECTOR AND STEM LEAD

Tube 142
Magnification: 3X

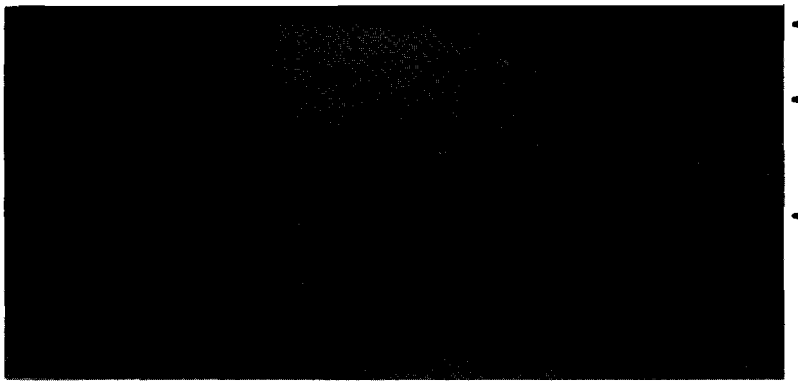


Figure 2

PHOTOMICROGRAPH OF STEM LEAD (NICKEL) WELDED
TO HEATER CONNECTOR (NICKEL-PLATED STEEL)

Tube 89
Magnification: 100X
Etch: KCN + $(NH_4)_2S_2O_8$
Longitudinal Section

axis) and shows excellent bonding. A photomicrograph (Figure 3) of the weld between the heater wire sleeve (nickel) and the heater connector (nickel-plated steel) shows good bond quality between the sleeve and the connector. The sleeve is normally pressed to the ends of the heater wires in the heater subassembly operation, and a mechanical bond (crimp) is established between the heater wire and sleeve. The photomicrograph indicates that welding of the inner sleeve surfaces has been accomplished. A photomicrograph of the heater wire/sleeve/connector area (Figure 4) shows proper spacing of the leads and projection of the ceramic insulator beyond the edge of the cathode sleeve.

B. Shock Test

Eight failures out of fifteen tubes shock-tested were reported by Tung-Sol. Two samples were rejected because of defective welds (tubes 114 and 118 open filament), two tubes developed cracks in the glass stem (tubes 114 and 119), and the remaining five reject tubes failed to meet the required end-point values during vibration testing.

Tubes 114 and 118 both had open filament-connector joints. Figure 5 shows the broken heater connector weld of tube 118. As pointed out in discussion of the heater cycling tests, the length of the stem leads was not sufficient to permit full contact with the connector. The right-hand connector in Figure 5 indicates the small area of contact; the left-hand connector shows the open joint. Examination of the broken weld indicated thinning of the connector tab in the joint area (an unsatisfactory joint-condition), resulting from imprecise alignment of the mating parts. The right-hand connector joint, although not broken, suffers from the same misalignment difficulties and does not represent a satisfactory geometry.

Tube 118 contained a grid-cathode short in section 2 of the triode, in addition to the open filament-connector joint. Figure 6 shows the bottom grid lateral (left side of photograph) in contact with the cathode sleeve. Evidence of rubbing contact is indicated by transfer of gold (from the grid lateral) to the surface of the nickel cathode.

The cracks in the glass base of tube 114 are shown in Figure 7. These cracks appear to have originated during the stem lead crimping operation and propagated during the shock test. Although the stem leads were examined after crimping and prior to assembly, the incipient cracks, if present, were undetected. The cracked stem of tube 119 (Figure 8) appears to be a normal shrinkage failure and does not show the shattered glass pillows surrounding the leads as for tube 114.

Comparison of the five tubes having high plate-voltage (Ep) values with tubes that successfully passed the shock test requirements indicated no significant difference in the physical arrangement of the anode-grid-cathode

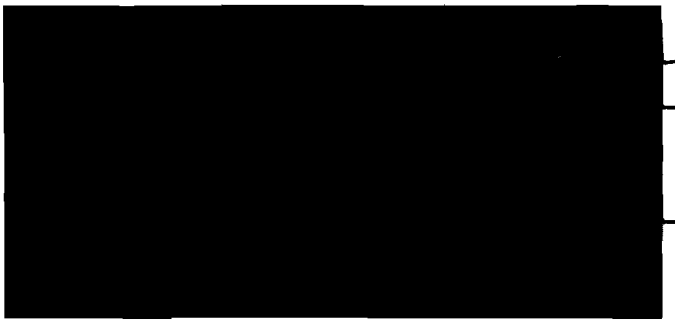


Figure 3

PHOTOMICROGRAPH OF HEATER WIRE (TUNGSTEN) IN SLEEVE (NICKEL) WELDED TO HEATER CONNECTOR (NICKEL-PLATED STEEL)

Tube 89
Magnification: 100X
Etch: 2 percent Natal
Transverse Section

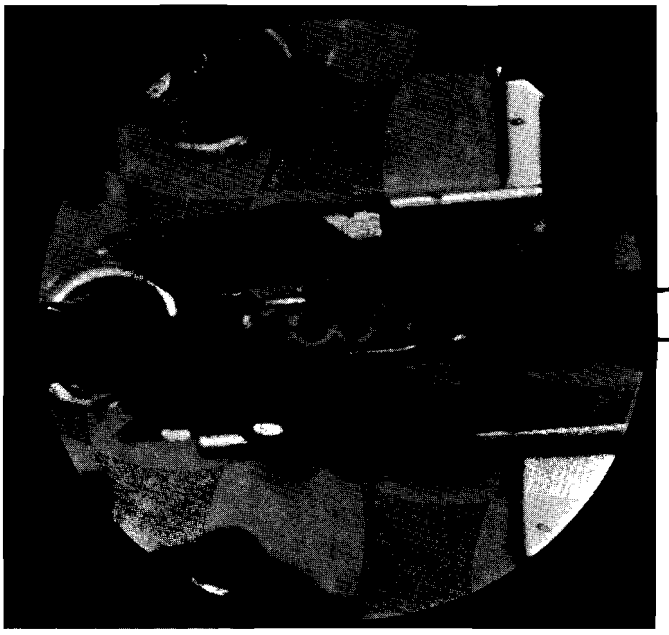


Figure 4

AREA OF HEATER WIRES IN SLEEVES WELDED TO HEATER CONNECTORS

Tube 89
Magnification: 3X

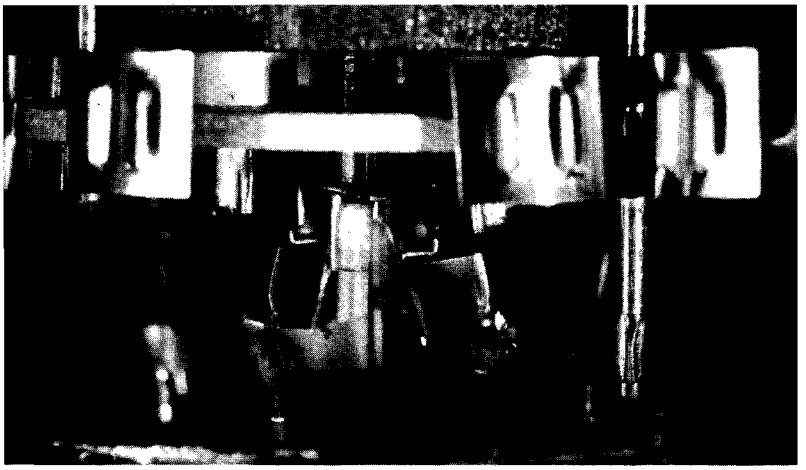


Figure 5

BROKEN WELD BETWEEN HEATER CONNECTOR AND STEM LEAD

Left-hand weld broken
Tube 118
Magnification: 3X

Figure 6

SHORT CIRCUIT BETWEEN BOTTOM GRID LATERAL AND CATHODE SLEEVE

Tube 118
Magnification: 5X

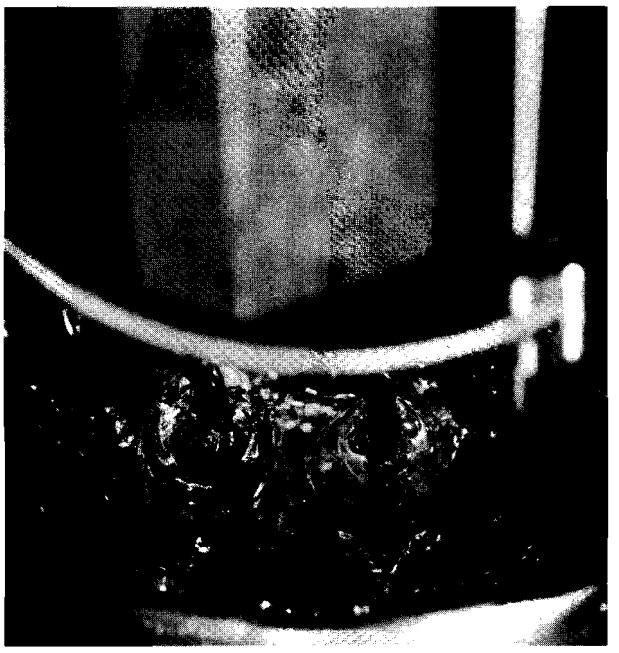


Figure 7

CRACKED STEM BASE AND SHATTERED GLASS PILLOWS

Tube 114
Magnification: 3X

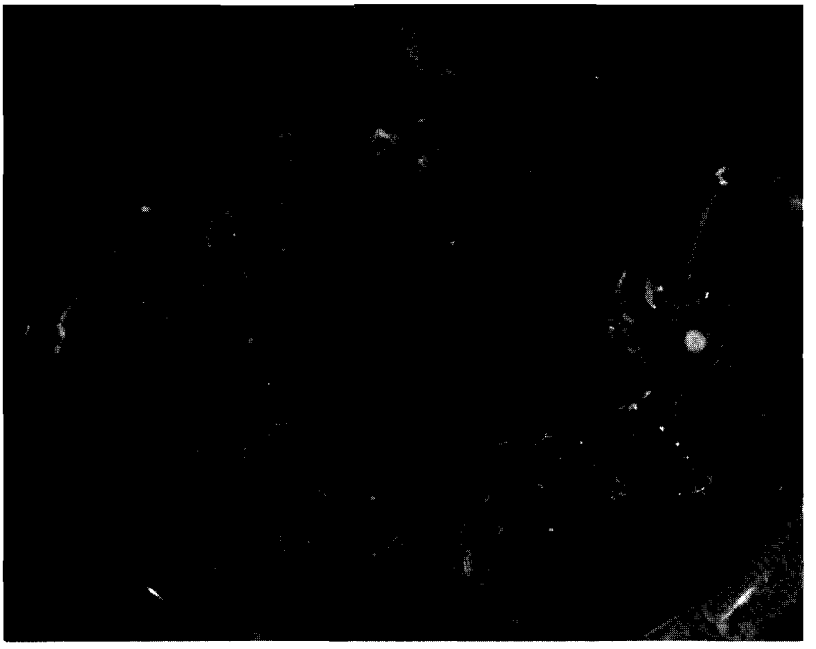


Figure 8

CRACKED STEM BASE

Tube 119
Magnification: 3X

sections. Since the Ep values are measured during vibration (dynamic) testing, the results indicate a condition which cannot be detected by static physical examination.

The most likely cause of the high plate voltage was the lack of restraint of the grid in the modified tube design. In the original design, grid radiators are welded to the top of the grid side rods, effectively locking the grid assembly between the ceramic spacers (the grid is secured to the bottom ceramic spacer by grid eyelets). When the grid radiators were deleted from the tube for ultrasonic welding, no provision was made to secure the grid rods at the top. Consequently the grid assembly was free to move, since the only restraint was imposed by the bottom eyelets and the grid connectors attached to the stem leads. Substitution of grid eyelets for the grid radiator on the top ceramic spacer would have prevented the grid from "floating." However, since this situation was not recognized during tube fabrication and testing conducted at Tung-Sol, there was no opportunity to initiate remedial action.

Other tube defects also might have been prevented by securing the grid in place. The short circuit of tube 118 (Figure 6) after shock test probably resulted from displacement of the grid. The shift in position of the grid can be observed in the spacing between the grid eyelet and bottom ceramic spacer (Figure 5).

C. Fatigue Test

Of the twenty tubes apportioned for the 96-hour fatigue test, only one successfully met the end-point requirements. Seven tubes had high Ep values in the pre-fatigue vibration test. One of these was within limits after the fatigue test; this was the tube that successfully met end-point requirements. Four of these seven also developed short circuits. Four additional tubes indicated high Ep values after the fatigue test. Two of the remaining tubes indicated high transconductance in Section 2, two contained cracks in the glass envelope, and five contained broken welds.

The cause of the seven pre-fatigue test high Ep values could not be determined by physical examination, but can probably be ascribed to the floating grid assembly described above under Shock Test. The four additional failures after testing may also be due to the floating grid.

The grid-cathode shorts indicated in tubes 143, 144, 149, and 154 were observed by examination of tubes. In the case of tube 154 (Figure 9), the hot cathode melted the grid lateral in the area of contact. The cracked bulb of tube 148 (Figure 10) most likely was caused by residual stress or incipient cracking during the bulbing operation.

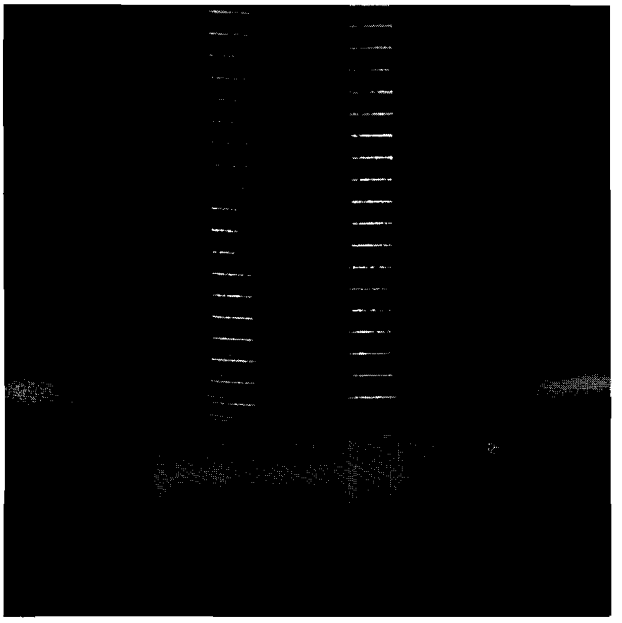


Figure 9

SHORT CIRCUIT BETWEEN GRID LATERAL AND CATHODE

Tube 154
Magnification: 5X

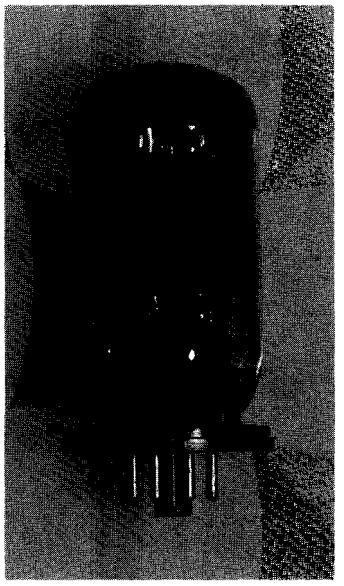


Figure 10

CRACK IN BULB BASE

Tube 148
Scale: 1/2X

Broken welds are illustrated in Figures 11-14. The two defective heater connector/stem lead welds (Figures 11 and 12) are attributable to the short stem lead misalignment conditions already described. The open top cathode connector tab shown in Figure 13 represents the only defective weld in this area within the entire group of tubes tested. The open cathode in Section 1 (Figure 14) was caused by a fracture at the edge of the weld between the snubber support rod and bottom cathode connector (stem lead). The break was caused by excessive thinning of the cathode connector resulting from welding deformation.

A more drastic example of weld failure is shown in Figure 15. Tube 151 contains fractures in the heater connectors and a bottom cathode connector as well as bending and twisting distortion of the remaining stem lead connectors. Comparison with a typical tube indicates that the entire cage assembly of tube 151 had been pulled away from the stem leads. It is doubtful that the fatigue test was responsible for the gross displacement of the cage within the bulb, and the cause of this defect can presumably be ascribed to loosening of the cage assembly by connector breakage during testing and subsequent damage during handling and/or shipping (the tubes were returned by commercial carrier to Aeroprojects from Tung-Sol for these analyses).

D. 2000-Hour Life Test

Twenty tubes were subjected to the 2000-hour life test. After the 1000-hour point, two tubes failed to meet standard (MIL-E-1/1121) 1000-hour end-point requirements. One tube (101) had failed at 280 hours; the other (104) met requirements at 760 hours but failed at 1020 hours. After 2000 hours, five more tubes failed to meet the 1000-hour requirements. All five had developed defects between 1500 and 2000 hours. Inspection of the welded joints in these seven tubes and in the remaining thirteen indicated that all ultrasonic welds survived the 2000-hour operation with no apparent adverse effects.

Both tubes that developed defects below 1000 hours indicated an open heater circuit. Examination showed that all welds associated with the heaters were satisfactory (Figure 16), but that the base pins on both tubes had not been soldered (Figures 17-18). The open heater circuits are very probably a result of this omission, and cannot be ascribed to defects associated with construction of tube mounts.

Of the five tubes that developed defects between 1500 and 2000 hours, one tube (100) developed a short circuit between the grid lateral and the cathode sleeve (Figure 19). Contact between the grid and cathode may have resulted either from mechanical damage or from elevated temperature distortion. A similar defect was observed in five tubes subjected to shock or fatigue testing (Figures 6 and 10).

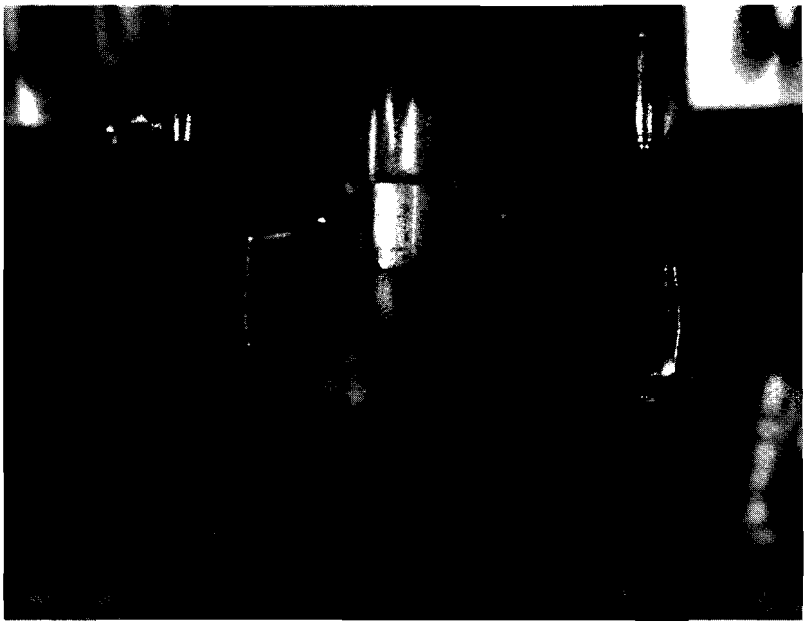


Figure 11

BROKEN WELD BETWEEN HEATER CONNECTOR AND STEM LEAD

Left-hand weld broken
Tube 153
Magnification: 5X

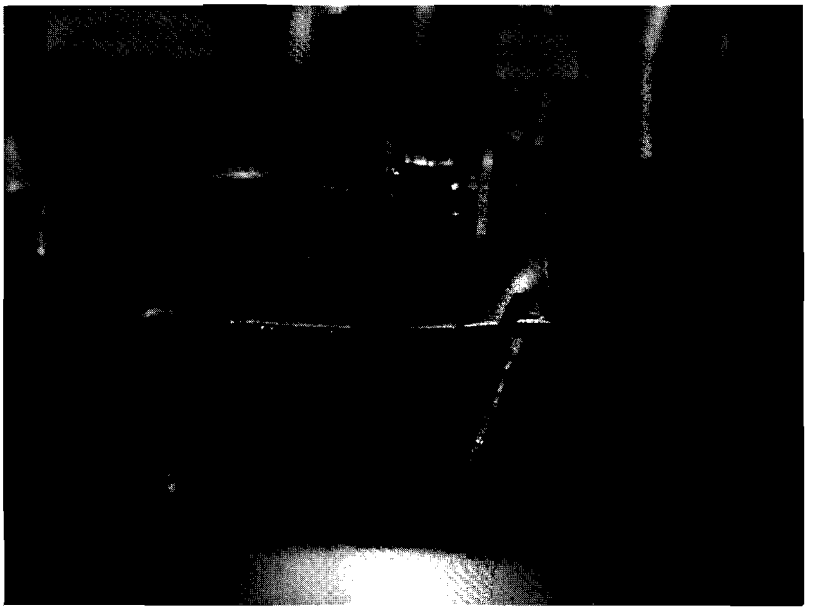


Figure 12

BROKEN WELD BETWEEN HEATER CONNECTOR AND STEM LEAD

Tube 137
Magnification: 5X

Figure 13

BROKEN WELD BETWEEN TOP CATHODE CONNECTOR AND CATHODE SLEEVE

Only one of the dual connector straps broken
Tube 139
Magnification: 5X

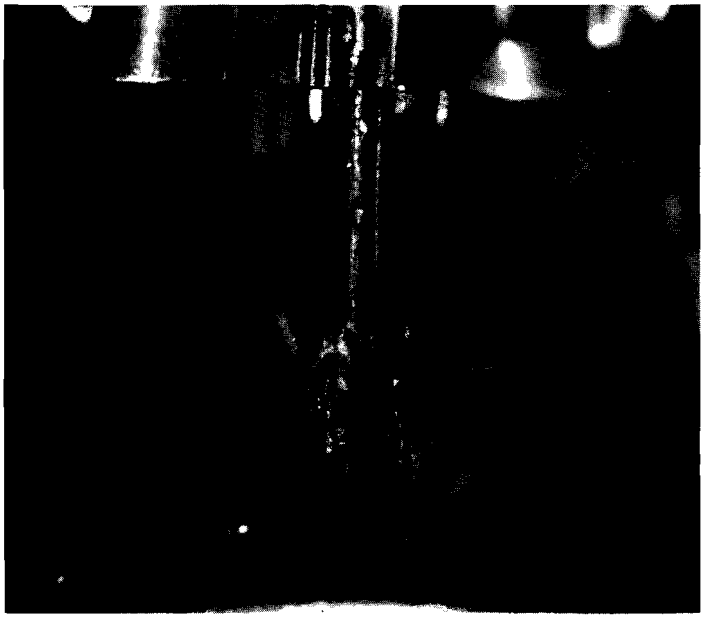
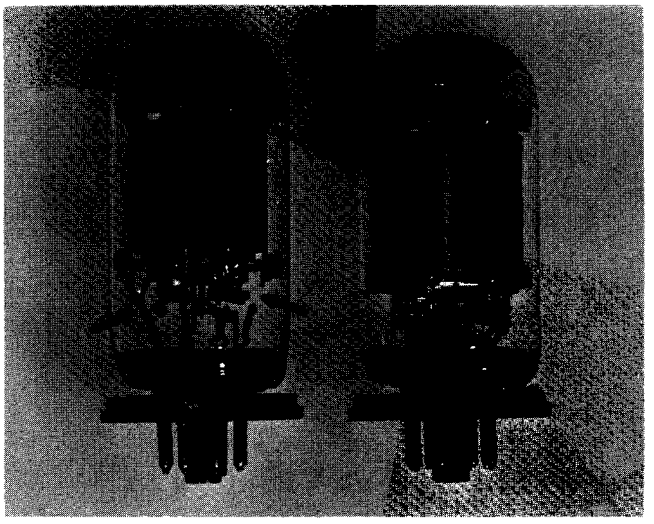


Figure 14

BROKEN CONNECTOR BETWEEN SNUBBER SUPPORT ROD AND BOTTOM CATHODE CONNECTOR

Tube 155
Magnification: 5X



Displaced Cage
Tube 151

Cage in Normal
Position
Tube 135

Figure 15

COMPARISON OF CAGE POSITION IN DAMAGED AND NORMAL TUBE

Note broken stem lead welds in damaged tube.
Scale: 1/2X

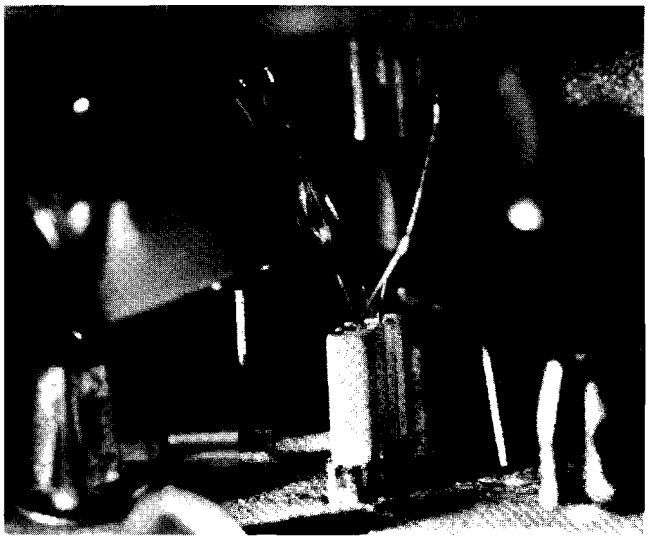


Figure 16

SATISFACTORY HEATER WIRE WELDS

Tube 101
Magnification: 5X

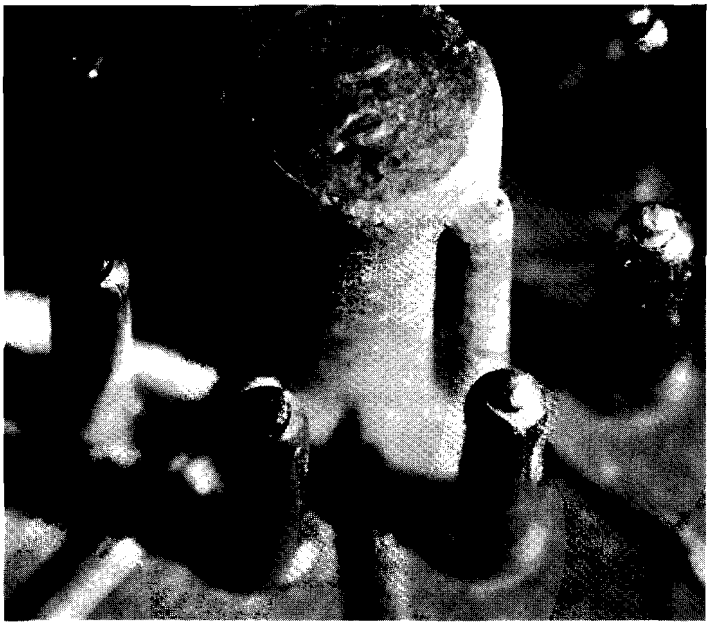


Figure 17

OCTAL BASE PINS, NOT SOLDERED

Arrows indicate heater pins
Tube 101
Magnification: 3X

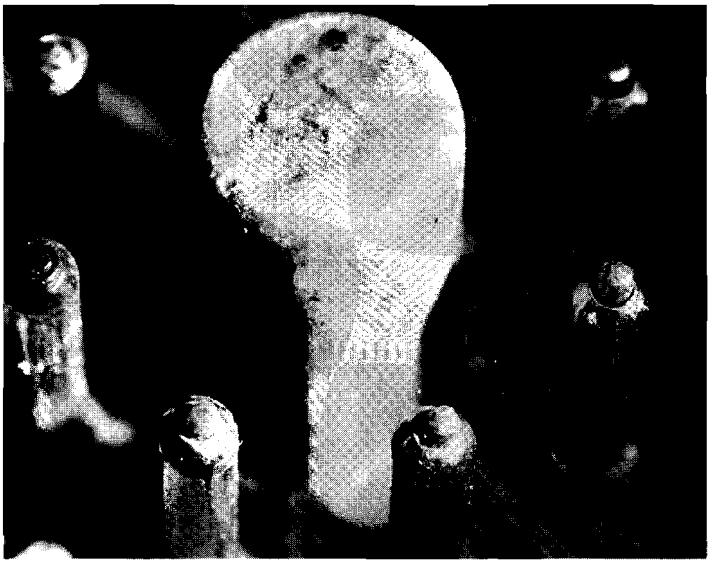


Figure 18

OCTAL BASE PINS, NOT SOLDERED

Arrows indicate heater pins
Tube 104
Magnification: 3X

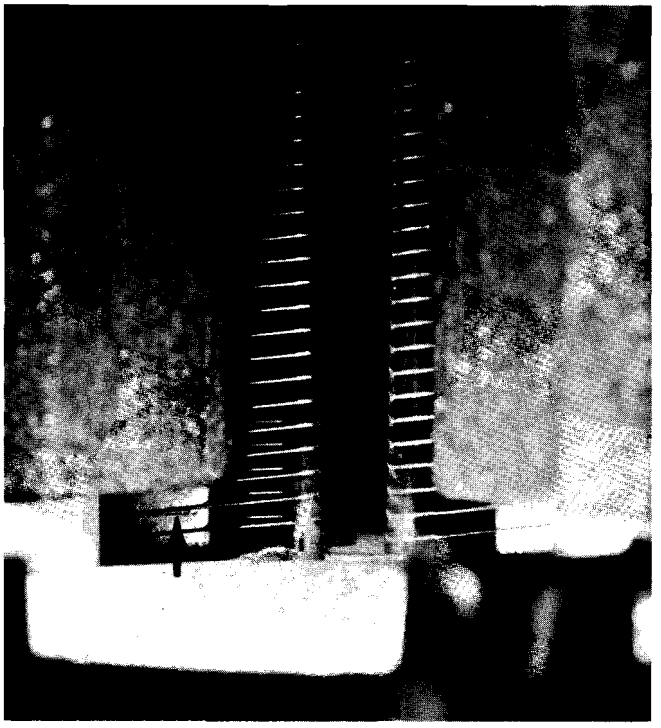


Figure 19

SHORT CIRCUIT BETWEEN GRID LATERAL AND CATHODE

Tube 100
Magnification: 3X

Tubes 78 and 91 developed high grid current, tube 79 developed heater-cathode leakage, and tube 88 developed both. Both these conditions reflect minute changes in the relative positions of the components and/or degradation of the materials (e.g., heater insulator) during operation. Observation of the causes is virtually impossible, because the tube mount cannot be disassembled for inspection without damaging or distorting the components.

Since the acceptance specification test is for 1000 hours, data on the performance of normal production tubes for a 2000-hour life test are not available. Hence no definite conclusions can be drawn regarding comparative tube performance at the 2000-hour operation level. However, since no significant changes were made in either tube geometry or materials, no differences are anticipated in the electrical characteristics of production tubes made by ultrasonic welding and resistance welding, unless ultrasonic welding results in degradation of the welded junctions and/or elevated temperature creep or distortion of metal components. It is significant that all 18 tubes tested (not counting the two with unsoldered base pins) met the end-point test requirement for the 1000-hour life test after 1500 hours. Over 70 percent (13) of the test group (18) were operative within specification values after 2000 hours.

E. Other Tests

Stability and survival rate tests and acceptance inspection tests were carried out on the remainder of 6080WB tubes (see Appendix B). Of these 25 tubes, only one (156, high Ep in y-position) failed to meet end-point requirements. No physical or metallurgical examination was carried out on these tubes.

III. CONCLUSIONS

The fabrication, testing, examination and analysis of the ultrasonically welded 6080WB (modified) electron tubes has clearly indicated the feasibility and potential capability of the ultrasonic welding process in electron tube manufacture, and a limited production capability for the 6080WB tube using this technique was established.

During the course of the tube fabrication, several problem areas were revealed wherein further work effort and experience will be of value:

1. Although all the metallic components were successfully joined by ultrasonic welding, the ceramic (AlSiMag) spacers normally used in production tubes were subject to fracture during the snubber-to-snubber rod welding. An alternative spacer material may alleviate this condition and allow the snubber welds to be made ultrasonically (as they were before the Fotoceram spacer was replaced with the AlSiMag spacer).

2. The configuration of the stem leads should be modified to permit better alignment with the various connecting tabs.

3. The grid frame should be secured to the top spacer by grid eyelets.

4. Second generation fixturing will insure very substantially improved alignment between components during welding.

5. Welder design and tooling should be re-examined in light of the experience gained in this work and of the advances made in equipment and techniques during this program. In this connection, a welding machine incorporating an axial-drive transducer-coupling system (as opposed to the wedge-reed system employed in the standard 600-watt welder used in this program) will simplify tooling requirements substantially without compromising accessibility or welding performance.

6. Proficiency in welder operation and tube assembly must be developed by operating personnel.

The results of this work indicate that a major proportion of the failures could have been averted by better control and skill in the assembly operation. Of the 35 defective tubes, including 5 that failed to meet 1000-hour end-point requirements after 2000 hours, only 7 rejects were directly attributable to weld defects or weld failure. It is possible that some of the remaining failures may have originated indirectly from this welding operation, such as residual stresses or microscopic distortion of components which finally led to short circuits or out-of-limit electrical

conditions, but the floating grid seems a more likely origin for such defects. Sixteen of the 35 defective tubes (approximately 46 percent) indicated high Ep values. Detection and elimination of the cause for these defects would logically be pursued during additional tube fabrication and test. Since complete test data are available for only selected lots of the initial 100 tubes, the exact cause of these failures cannot be determined.

The following is concluded:

1. The feasibility of ultrasonically welding electron tube components to produce acceptable assemblies has been demonstrated with a slightly modified 6080 WB twin triode.

2. One hundred 6080WB tubes were assembled with generally standard components used in current manufacturing procedures and subjected to acceptance and qualification tests according to MIL-E-1/1121A. Only 7 failures resulting from welding defects were encountered in the test group.

3. Failure of 16 tubes to meet the required Ep end points specified in MIL-E-1/1121A was due to causes which were not directly disclosed by this investigation, but which appear to be associated with failure to secure the grid assembly.

4. All the ultrasonically welded connections in the 6080WB were accomplished with a standard 600-watt ultrasonic welder. Special welding tips and tools were designed, fabricated, and adapted to the standard welder to accomplish welds in the various joint geometries of the 6080WB tube elements without significant modification of the tube design.

APPENDIX A

ASSEMBLY SEQUENCE FOR ULTRASONICALLY WELDED 6080WB ELECTRON TUBES

Table A-I

SUMMARY OF ASSEMBLY SEQUENCE

Sequence No.	Tip	Anvil	Operation
1A	T-1	A-1	Weld cathode tabs to cathode sleeves (2 required)
Subassembly	-	-	Assemble two sleeves into top spacer
1B	T-1	A-1	Weld looped cathode tab to sleeve
1C	T-1	A-1	Repeat above on second sleeve
Subassembly	-	-	Assemble tube cage
2	T-2	A-2	Crimp anode eyelets to anode support rods
3A	T-2	A-2	Weld anode connectors $\binom{17876}{17877}$ to anode support rods
3B	T-2	A-2	Weld anode eyelets to anode support rods
4A	T-3	A-2	Weld grid eyelets (2) to grid supports
4B	T-3	A-2	Weld outside grid connectors (17882) to grid supports
Subassembly	-	-	Assemble right-hand heater connector
4C	T-3	A-2	Weld inside grid connectors (17883) to grid supports
Subassembly	-	-	Assemble heaters in cathode sleeve
			Insert heater wire sleeves (8)
5A	T-1	A-1	Weld alternate heater sleeves to right-hand heater connector
Subassembly	-	-	Insert left-hand heater connector
5B	T-1	A-1	Weld alternate heater sleeves to left-hand heater connector
6A	T-4	A-4 Position 1	Weld grid connectors to pins 1 and 4
6B	T-4	A-4	Weld anode connectors to pins 2 and 5
6C	T-4	A-4	Weld cathode connectors to pins 3 and 6 and heater connectors to pins 7 and 8

(Continued)

Table A-I (Concluded)

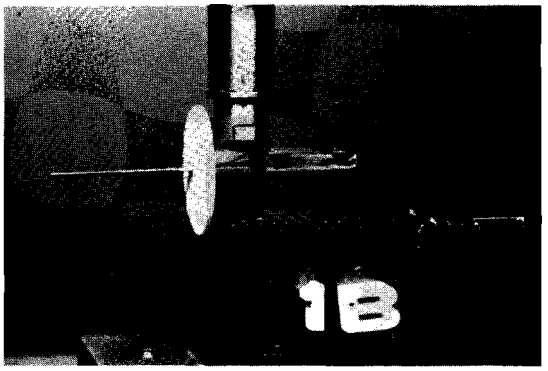
Sequence No.	Tip	Anvil		Operation
7A	T-4	A-4	Pos. 1	Weld cathode connector to snubber support rod
7B	T-4	A-4	Pos. 1	Weld cathode connector to snubber support rod
8A	T-4	A-4	Pos. 2	Weld top cathode connector to snubber support rod
8B	T-4	A-4	Pos. 2	Weld top cathode connector to snubber support rod
9A	T-1	A-2		Weld cathode tab to cathode connector (anvil insert inverted)
9B	T-1	A-2		Weld cathode tab to cathode connector (anvil insert inverted)
10	T-6	A-6		Weld getter to snubber support rod
11A*	T-5	A-5		Weld snubber to snubber support rods
11B*	T-5	A-5		Weld snubber to snubber support rods

* Final tube assemblies utilized resistance welding because of propensity of ceramic spacers to cracking.

ILLUSTRATED ASSEMBLY SEQUENCE

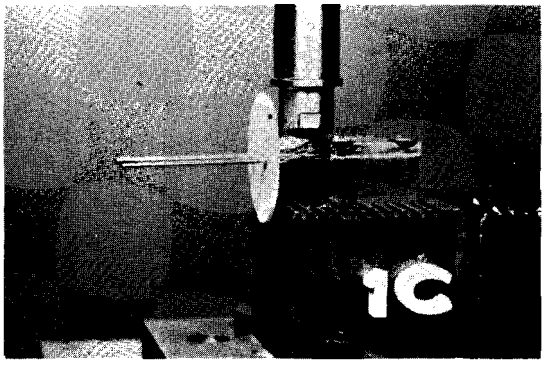
Assembly Sequence 1A

Welding cathode tab to cathode sleeve



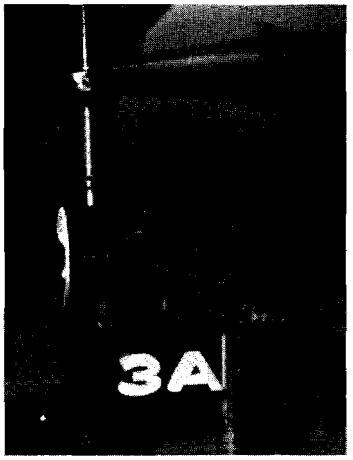
Assembly Sequence 1B

Welding cathode tab looped through AlSiMag spacer to cathode sleeve



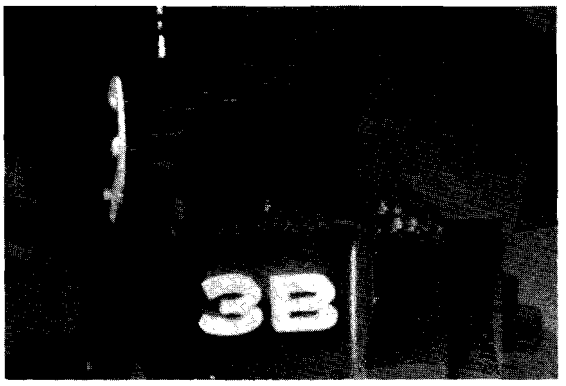
Assembly Sequence 1C

Repeat of 1A and 1B on twin cathode sleeve



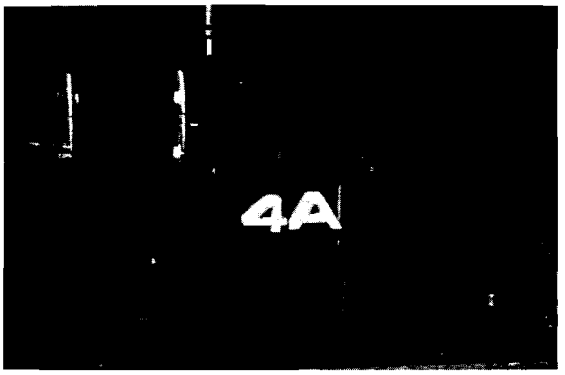
Assembly Sequence 3A

Welding anode connectors to anode support rod



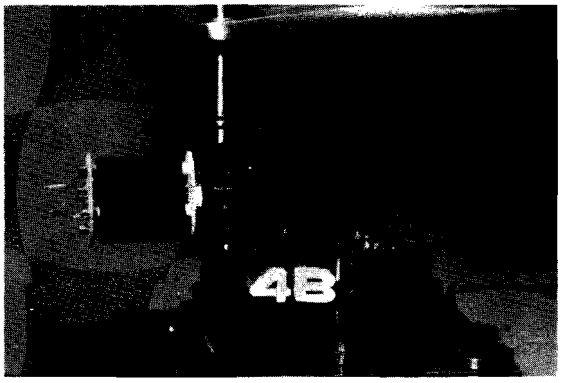
Assembly Sequence 3B

Welding anode eyelets to anode support rods



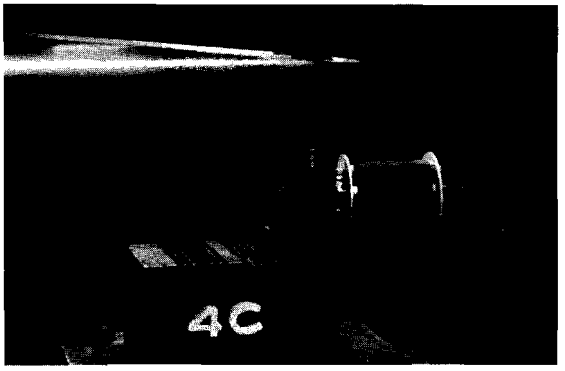
Assembly Sequence 4A

Welding grid eyelets to grid support



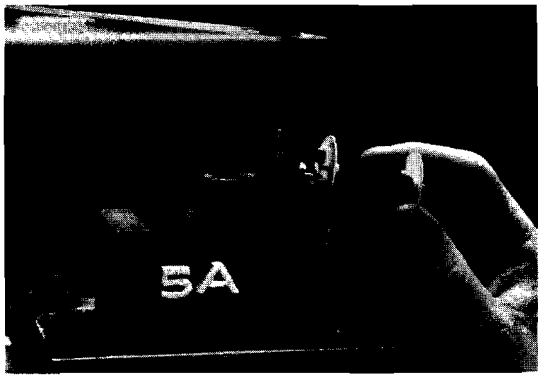
Assembly Sequence 4B

Welding outside grid connector to grid support



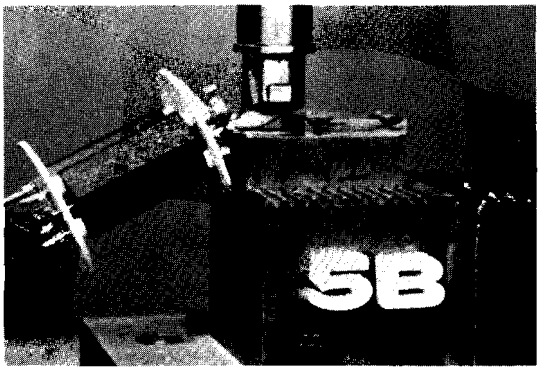
Assembly Sequence 4C

Welding inside grid connector to grid support



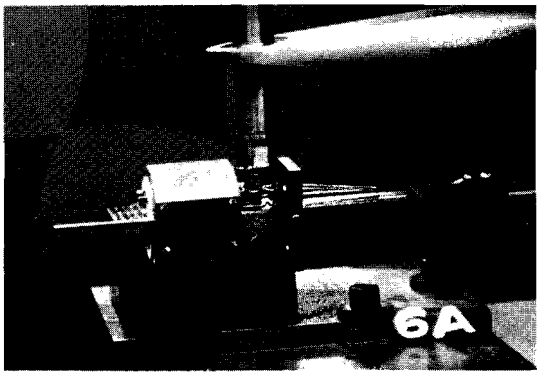
Assembly Sequence 5A

Welding heater wire sleeves to right-hand heater connector



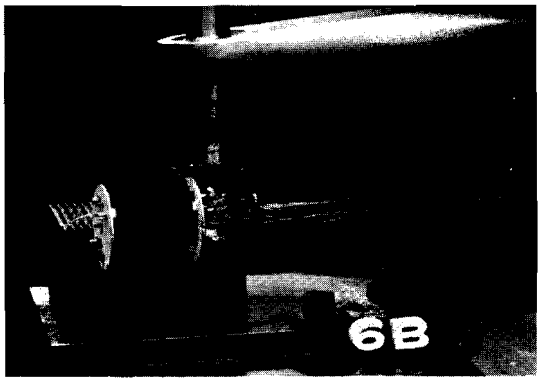
Assembly Sequence 5B

Welding heater sleeves to left-hand heater connector



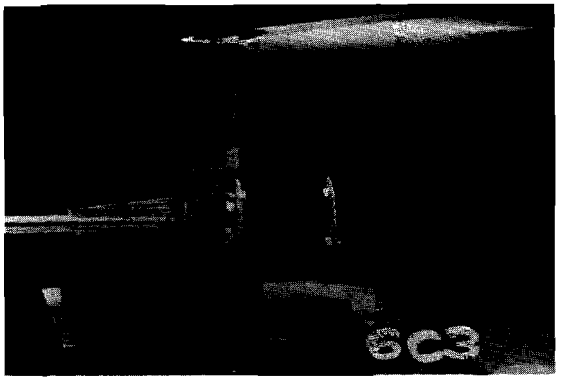
Assembly Sequence 6A

Welding grid connectors to stem leads (pins 1 and 4)



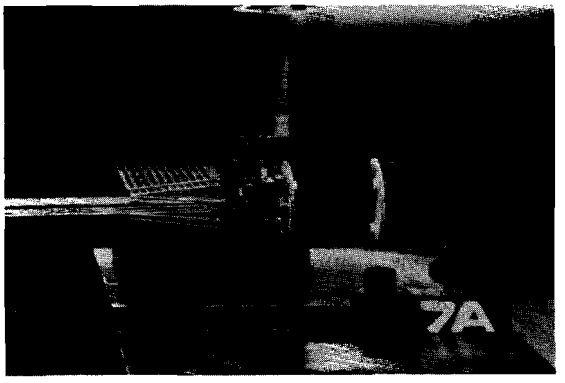
Assembly Sequence 6B

Welding anode connectors to stem leads (pins 2 and 5)



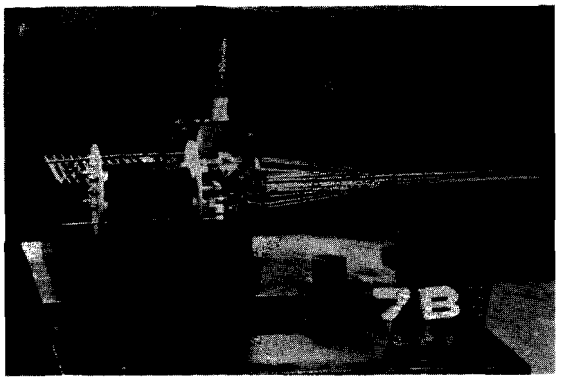
Assembly Sequence 6C

Welding cathode connectors to pins 3 and 6
Welding heater connectors to pins 7 and 8



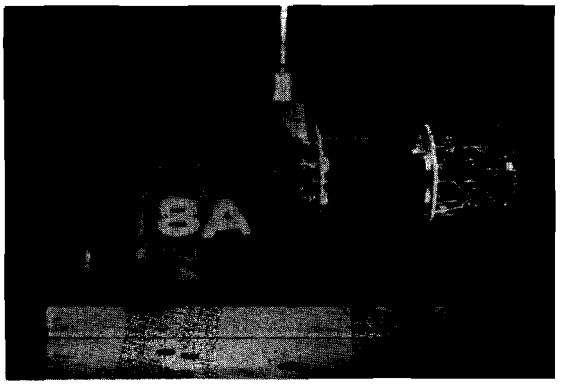
Assembly Sequence 7A

Welding cathode connector to snubber support rod (Section 2)



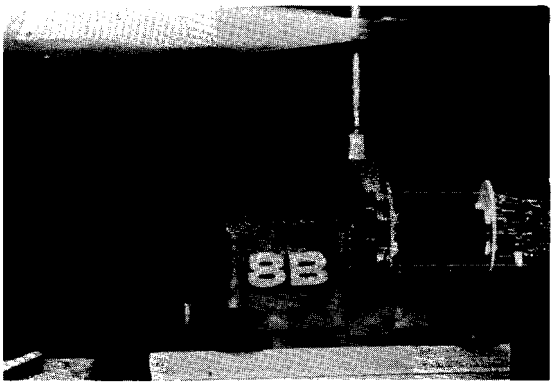
Assembly Sequence 7B

Welding cathode connector to snubber support rod (Section 1)



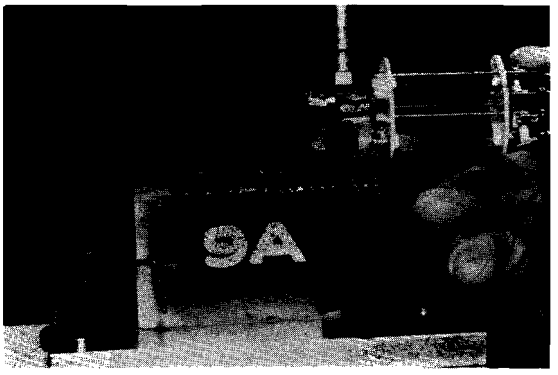
Assembly Sequence 8A

Welding top cathode connector to snubber support rod (Section 2)



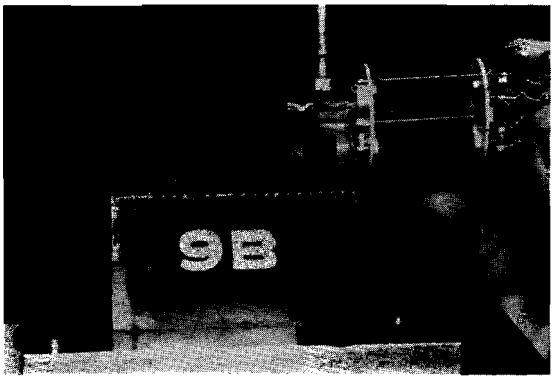
Assembly Sequence 8B

Welding top cathode connector to snubber support rod (Section 1)



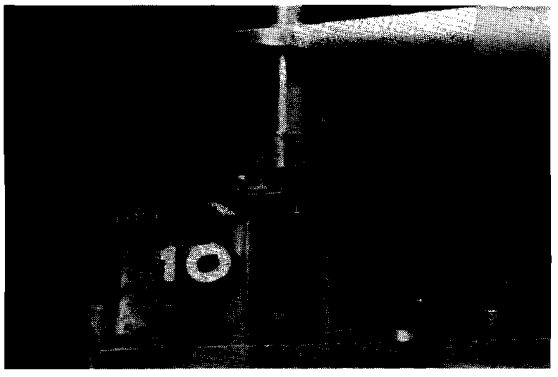
Assembly Sequence 9A

Welding cathode tab to cathode connector (Section 1)



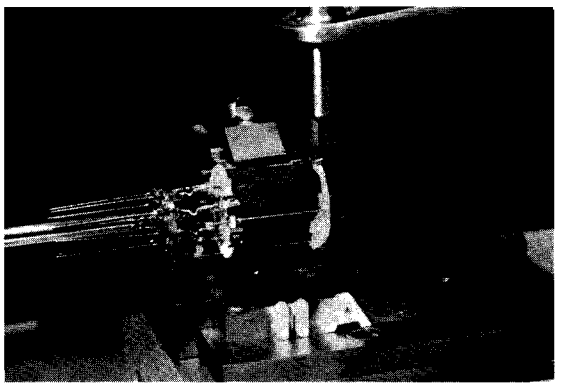
Assembly Sequence 9B

Welding cathode tab to cathode connector (Section 2)



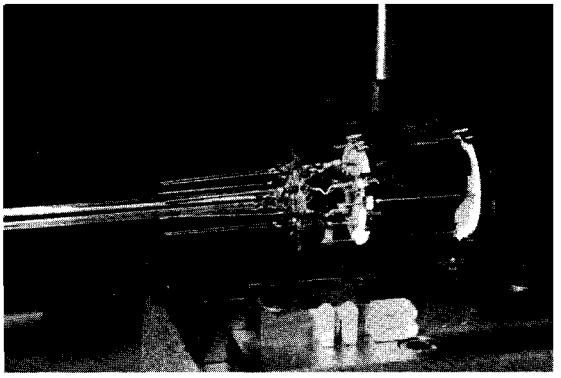
Assembly Sequence 10

Welding getter to snubber support rod



Assembly Sequence 11A*

Welding snubbers to snubber support rods (position 1)



Assembly Sequence 11B*

Welding snubbers to snubber support rods (position 2)

* The AlSiMag spacers were prone to cracking and fracture during this welding operation. Tubes fabricated for test employed resistance welds between the snubbers and snubber support rods.

APPENDIX B

TEST DATA FOR ULTRASONICALLY WELDED ELECTRON TUBES

Preproduction Test for Tube Type 6080WB

Using Ultrasonic Welding Techniques

The Ultrasonic Welding Equipment Was Developed by

Aeroprojects Inc., West Chester, Penn.

Tung-Sol Electric Inc. is the Sub-Contractor

for Aeroprojects Inc.

Date of Test: Started 3-9-66

Completed 5-22-66

Witnessed By: Simon Zucker

Mr. Simon Zucker, U.S. Army Electronic Command

John H Thomas

Mr. John Thomas, Aeroprojects Inc.

Ralph George

Mr. Ralph George, Mgr. Applications Dept., Tung-Sol Electric Inc.

Performed at Tung-Sol Electric Inc. in

Bloomfield, N. J. and Livingston, N. J.

LIST OF TEST FACILITIES

NAME OF APPLICANT: TUNG-SOL ELECTRIC INC. DATE: 20 January 1966
TESTING FACILITY: Tung-Sol Electric Inc. SPEC. NO: MIL-E-1E
ADDRESS: 200 Bloomfield Ave., Bloomfield, N. J. AMEND: 2 SUPPLEMENT:

SPEC. PARA.	EQPT.	MFR.	TYPE OR MODEL	SERIAL OR INVENTORY NO.	DESCRIPTION AND USE (Include Dimensions, Measuring Devices and Controls as applicable)	EQPT LIMITS (Include Multiple Ranges)	ACCURACY	DATE AND FREQ OF CALIBRATION
N/A	Bridge Console	Tung-Sol	39-0-0	5;E2648-A-364	Measurement of tube characteristics, including dynamic Parameters by the use of a Gen Radio Model 1661A vacuum tube bridge	N/A	N/A	N/A
4.10.9	Vacuum tube Bridge	General Radio	1661A	A115	Measurement of transconductance at Ikc	.02 to 50,000 µmhos	±2%	Jan. 10, 1966 Quarterly
4.10.10	Vacuum Tube Bridge	General Radio	1661A	A115	Measurement of plate resistance at Ikc	50Ω to 20 meg.	±2%	Jan. 10, 1966 Quarterly
4.10.11.1	Vacuum Tube Bridge	General Radio	1661A	A115	Measurement of amplification factor at Ikc	.001 to 10,000	±2%	Jan. 10, 1966 Quarterly
4.10.4	DC Voltmeter	Greibach	540	2600	Measurement of various electrode potentials	0-1.5/3/7.5/15/30/75/150/300/750V DC	±1/2%	Jan. 10, 1966 Quarterly
4.10.4.1	DC Milli-ammeter	Greibach	540	2596	Measurement of plate current	0-1.5/3/7.5/15/30/75/150/300 Ma DC	±1/2%	Jan. 10, 1966 Quarterly
4.10.4.3	DC Milli-ammeter	Greibach	540	2597	Measurement of screen current	0-1.5/3/7.5/15/30/75/150/300 Ma DC	±1/2%	Jan. 10, 1966 Quarterly

LIST OF TEST FACILITIES

NAME OF APPLICANT: TUNG-SOL ELECTRIC INC. DATE: 20 January 1966
TESTING FACILITY: Tung-Sol Electric Inc. SPEC. NO: MIL-E-1E
ADDRESS: 200 Bloomfield Ave., Bloomfield, N. J. AMEND: 2 SUPPLEMENT:

SPEC. PARA.	EQPT.	MFR.	TYPE OR MODEL	SERIAL OR INVENTORY NO.	DESCRIPTION AND USE (Include Dimensions, Measuring Devices and Controls as applicable)	EQPT LIMITS (Include Multiple Ranges)	ACCURACY	DATE AND FREQ OF CALIBRATION
1031	Variable Frequency Shaker	Calidyne	A-88	85	Sinusoidal Shaker with 100 lbs. force rating, with sweep freq. provisions and facilities for X,Y, and Z orientations; equipped with Servo control to maintain either constant acceleration or constant amplitude vs. frequency; complete with power supply for tube under test.	Output = 100 lbs. - force max. Freq. Range = 5 to 2500 cycles	±5% (Acceleration ±20% (Frequency)	Jan. 5, 1966 Quarterly
4.10.8	AC Volt Meter	Weston	741	53554-1	Measurement of filament volt.	0-3/7.5/15/30/ 75/150V AC	1%	Jan. 5, 1966 Quarterly
4.10.5.2 & 4.10.5.3	DC Volt Meter	Weston	741	53554-2	Measurement of Ec1 volt.	0-3/7.5/15/30/ 75/150V DC	1%	Jan. 5, 1966 Quarterly
	DC Volt Meter	Weston	741	53554-3	Measurement of plate volt.	0-15/30/75/ 150/300V DC	1%	Jan. 5, 1966 Quarterly
	DC Volt Meter	Weston	741	53554-4	Measurement of Ec2 volt.	0-15/30/75/ 150/300V DC	1%	Jan. 5, 1966 Quarterly
4.10.4.1	DC Milli-ammeter	Weston	741	50175-5	Measurement of plate current	0/30/75/150 Ma	1%	Jan. 5, 1966 Quarterly

LIST OF TEST FACILITIES

NAME OF APPLICANT: TUNG-SOL ELECTRIC INC. DATE: 20 January 1966
TESTING FACILITY: Tung-Sol Electric Inc. SPEC. NO: MIL-E-1E
ADDRESS: 200 Bloomfield Ave,, Bloomfield, N. J. AMEND: 2 SUPPLEMENT:

SPEC. PARA.	EQPT.	MFR.	TYPE OR MODEL	SERIAL OR INVENTORY NO.	DESCRIPTION AND USE (Include Dimensions, Measuring Devices and Controls as applicable)	EQPT LIMITS (Include Multiple Ranges)	ACCURACY	DATE AND FREQ OF CALIBRATION
1211	Insulation Resistance	Tung-Sol	N/A	E-8099A-332	Measurement of insulation resistance of electrodes. Resistance is computed from $R = \frac{E}{I}$	At 100 volts E, 0-1/10/100/1000/10K/100,000 megs. At 300 Volts E, Multiply above by 3; at 500 volts E, mult. above by 5.	N/A	N/A
4.10.8	AC Voltmeter	Weston	476	N/A	Measurement of filament volt.	0-4/8/40/80/120V AC	±2%	Jan. 5, 1966 Quarterly
4.10.5.2 & 4.10.5.3	DC Voltmeter	Weston	301	N/A	Measurement of interelectrode voltage	0-500V DC	±2%	Jan. 5, 1966 Quarterly
4.10.4.1	DC Micro-ammeter	RCA	WV-84A	1030	Measurement of interelectrode current	0-.01/.1/1/10/100/1000 μa DC	±5%	Prior to each use

LIST OF TEST FACILITIES

NAME OF APPLICANT: TUNG-SOL ELECTRIC INC. DATE: 20 January 1966
TESTING FACILITY: Tung-Sol Electric Inc. SPEC NO: MIL-E-1E
ADDRESS: 200 Bloomfield Ave., Bloomfield, N.J. AMEND: 2 SUPPLEMENT:

SPEC. PARA.	EQPT.	MFR.	TYPE OR MODEL	SERIAL OR INVENTORY NO.	DESCRIPTION AND USE (Include Dimensions, Measuring Devices and Controls as applicable)	EQPT LIMITS (Include Multiple Ranges)	ACCURACY	DATE AND FREQ OF CALIBRATION
4.10.4.2	DC Milliammeter	Greibach	540	2598	Measurement of anode #3 current	0-1.5/3/7.5/15/30/75/150/300 Ma DC	±1/2%	Jan. 10, 1966 Quarterly
4.10.8	DC Milliammeter	Greibach	540	2599	Measurement of DC filament current	0-75/150/300/750/1500/3000 Ma DC	±1/2%	Jan. 10, 1966 Quarterly
4.10.6.1	DC Microammeter	Greibach	700	2602	Measurement of control grid current	0-.3/.75/1.5/3/7.5/15/30/75 µa DC	±1/2%	Jan. 10, 1966 Quarterly
4.10.4.1	DC Microammeter	Griebach	700	2601	Measurement of low level plate current	0-1.5/3/7.5/15/30/75/150/300/750/1500 µa DC	±1/2%	Jan. 10, 1966 Quarterly
4.10.8	AC Voltmeter	Weston	924	4358	Measurement of AC filament voltage	0-7.5/15/30/75/150V AC	±1%	Jan. 10, 1966 Quarterly

LIST OF TEST FACILITIES

NAME OF APPLICANT: TUNG-SOL ELECTRIC INC. DATE: 20 January 1966

TESTING FACILITY: Tung-Sol Electric Inc. SPEC. NO: MIL-E-1E

ADDRESS: 200 Bloomfield Ave., Bloomfield, N.J. AMEND: 2 SUPPLEMENT:

SPEC. PARA.	EQPT.	MFR.	TYPE OR MODEL	SERIAL OR INVENTORY NO.	DESCRIPTION AND USE (Include Dimensions, Measuring Devices and Controls as applicable)	EQPT LIMITS (Include Multiple Ranges)	ACCURACY	DATE AND FREQ OF CALIBRATION
1301 & 1336	Heater-Cathode Leakage Set	Tung-Sol	Code 688	10688	Measurement of heater-cathode leakage	N/A	N/A	N/A
4.10.15	DC Volt-meter	Hickok	68—	035	Measurement of heater-cathode potential	0-500V	±2%	10-23-65 Semi-annually
4.10.15	DC Micro-ammeter	Weston	301	0484	Measurement of heater-cathode leakage current	0-200μa DC	±2%	10-23-65 Semi-annually
4.10.15	AC Volt-meter	Hickok	69X	046	Measurement of filament voltage	0-10V AC	±2%	10-23-65 Semi-annually

Dec 2-1965
HRJ

FORM NBS-443
(REV. 4-11-63)

U.S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS
WASHINGTON, D.C. 20234

NATIONAL BUREAU OF STANDARDS
REPORT OF CALIBRATION

K-2 POTENTIOMETER
Leeds and Northrup Serial No. 526758
Catalog No. 7552

Submitted by

Tung-Sol Electric Inc.
Bloomfield, New Jersey

Tests of the adjustments of the main dial, the standard-cell dial, the slide-wire, and the factors of this potentiometer were made in November 1965, at a room temperature of about 23°C. With the current adjusted so as to produce a potential difference between the standard-cell terminals equal to the reading of the standard-cell dial, the potential difference between the "E.M.F." terminals can be expressed by the following equation:

$$E = F(1+f)[D+d+0.0001(D_s+d_s)]$$

Here E is the potential difference between the "E.M.F." terminals expressed in the same unit as the electromotive force of the standard cell used with the instrument; F, D, and D_s are the factor, main dial, and slide-wire readings respectively; f, d, and d_s are the corrections to these readings. The corrections are to be taken from the following tables:

Factor Switch Reading F and Correction f

F	f
1	0.00000
0.1	+ .00001
0.01	.0000

211.01/187059

Factor Switch Setting	
1.0	0.005% E or 10μv, whichever is greater.
0.1	0.007% E +0.2 of the smallest subdivision of the slide wire.
0.01	0.015% E +0.2 of the smallest subdivision of the slide wire.

To obtain this accuracy, however, in case E is less than 0.02 volt usually it will be necessary to correct for thermoelectromotive forces within the potentiometer and within the circuit of the connected galvanometer.

When the reading of the factor switch is changed, the current through the potentiometer should be readjusted, if necessary, to produce a potential difference between the standard-cell terminals equal to the reading of the standard-cell dial.

For the Director

Chester Peterson, Chief
Resistance and Reactance Section
Electricity Division
Institute for Basic Standards

Test No. 211.01/187059
Date: December 2, 1965
Reference: BL-15303

CERTIFICATE
for
WESTON STANDARD CELL

SERIAL NO. 8658

This is the unsaturated form of Weston Cadmium Cell. By direct comparison at the Weston Laboratories, with normal cells standardized by the National Bureau of Standards, the electromotive force of this cell is 1.01897 Absolute Volts at 25.0 °C

Absolute Volt: The value of the emf certified is based upon the Absolute Volt agreed upon by the International Committee on Weights and Measures and adopted by the National Bureau of Standards, January 1st, 1948. It is maintained by the saturated form of Weston Cadmium Cell, known as the Weston Normal Cell, the emf of which is 1.018636 Absolute Volts at 20°C.

Temperature Coefficient: The temperature coefficient of this cell is less than 0.00001 per degree centigrade, and considered negligible for ordinary changes in temperature.

Effect of Time and Use: The electromotive force of standard cells decreases slightly with use and time. For purposes of instrument standardization the error produced by this change is negligible if the cell is properly used. For measurements requiring great precision, for example 0.02 per cent or better, or if there is a possibility of the cell having been misused, it is recommended that the cell be returned for recertification at intervals of one or two years.

PRECAUTIONS

a. The cell should not be exposed to temperatures below 4°C or above 40°C.

b. Although the temperature coefficient is negligible, small but appreciable errors result if the cell is subjected to sudden changes in temperature, or to unequal heating. It should be kept at a reasonably constant temperature sufficiently long to permit all parts of the cell to reach the same temperature, and sources of heat should be kept at a distance.

c. Standard cells should not be used in circuits where the cell current is continuous or at any time in excess of 0.0001 ampere. To limit the current it is desirable to have a protecting resistor connected in series with the cell, at least until a balance with an opposing emf is nearly obtained.

d. When sending the cell for recertification or for any other reason, it should be packed with great care to prevent shock during shipment. Any damage resulting from improper packing must be the responsibility of the sender.

WARRANTY

This product is warranted to be of good workmanship and quality and free from defects in manufacture. Our liability is limited to repairing such defects, provided it is returned prepaid to the Repair Service Division, Weston Instruments, Division of Daystrom, Incorporated, Newark , New Jersey within one (1) year after delivery to the original purchaser. We shall not be liable for consequential damages. This warranty is in lieu of all other warranties, guaranties, liabilities or obligations, statutory or implied, to the original purchaser or to any other person.

Date March 30, 1965

By Clarence G. Brunner Approved J. McLaren

WESTON INSTRUMENTS, INC.
614 Frelinghuysen Ave., Newark, N. J. 07114

FORM NBS-443
(REV. 4-11-63)

U.S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS
WASHINGTON, D.C. 20234

NATIONAL BUREAU OF STANDARDS
REPORT OF CALIBRATION

MULTIRANGE SHUNT
Tung-Sol Electric Serial No. T-S No. 1

Submitted by

Tung-Sol Electric Inc.
Bloomfield, New Jersey

Measurements were made on this shunt box in December 1965, at a room temperature of about 22°C. The resistance of each section was determined as a four terminal resistor, using the binding post marked "-" as a common current and potential terminal. The binding posts marked "MILLIAMPERES" was used as the other potential terminal. The resistance values, in ohms, were found to be as follows:

Positive Terminal	Resistance
1.5	1000.120
3	499.901
7.5	199.704
15	99.9904
30	50.0044

At the time of calibration, and under the conditions specified it as unlikely that the values given above were in error by more than 0.005 percent. This uncertainty estimate includes allowance for both systematic and random errors occurring in the calibration procedure.

For the Director

Chester Peterson, Chief
Resistance and Reactance Section
Electricity Division

Test No. 211.01/187113
Date: December 6, 1965
Order No. BL-15302

FORM NBS-443
(REV. 4-11-63)

U.S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS
WASHINGTON, D.C. 20234

NATIONAL BUREAU OF STANDARDS

REPORT OF CALIBRATION

MULTI-RANGE STANDARD RESISTOR FOR CURRENT MEASUREMENTS
Leeds and Northrup Company
Serial No. 526162

Submitted by

Tung-Sol Electric Company
200 Bloomfield Avenue
Bloomfield, New Jersey

The resistance of the several sections of this standard, when measured in November, 1965, after temperature equilibrium had been attained under the conditions specified below, had the following values.

Room Temperature °C	Test Current Amperes	Resistance Ohms
23	1.5	$0.2 \times 1.0005_2$
	0.6	$0.5 \times 1.0006_4$
	0.3	$1 \times 1.0005_0$
	0.15	$2 \times 1.0003_9$
	0.06	$5 \times 1.0003_8$
	0.03	$10 \times 1.0004_3$
	0.015	$20 \times 1.0003_4$

It is very unlikely that the above values of resistance are in error by more than 0.01 percent. This figure includes an allowance for both the random and systematic errors of the calibration process.

For the Director
by

F. L. Hermach

F. L. Hermach, Chief
Electrical Instruments Section
Electricity Division
Institute for Basic Standards

211.03/187058
Your Order No. BL-15302 .
November 24, 1965

FORM NBS-443
(REV. 4-11-63)

U.S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS
WASHINGTON, D.C. 20234

NATIONAL BUREAU OF STANDARDS
REPORT OF CALIBRATION

VOLT BOX
Leeds and Northrup Company
Serial No. 525223

Submitted by

Tung-Sol Electric Inc.
200 Bloomfield Avenue
Bloomfield, New Jersey

This volt box was tested at rated voltage in December, 1965, the room temperature and relative humidity being 23°C and 45%, respectively. The values of ratio given in the table were obtained under the test conditions set forth in this report.

Voltage Range	Voltage Ratio
750	$500 \times 0.9999_0$
300	$200 \times 1.0000_0$
150	$100 \times 1.0000_2$
75	$50 \times 1.0000_7$
30	$20 \times 1.0001_0$
15	$10 \times 1.0000_9$
7.5	$5 \times 1.0000_7$
3	$2 \times 1.0000_1$

Measurements indicate that large changes in ratio arise from self-heating. The value given in the table for the 750/1.5 ratio at rated voltage was obtained two hours after voltage was first applied. During this interval, the value of this ratio increased rapidly from $500 \times 1.0000_4$ to a maximum of $500 \times 1.0001_0$ within the first ten minutes and then gradually decreased to its equilibrium value given in the table. The remaining ratios were measured in succession after equilibrium was reached on the given range.

211.03/187060

Tung-Sol Electric Inc.
Volt Box
Serial No. 525223

It is very unlikely that the above values of ratio are in error by more than 0.005 percent. This figure includes an allowance for both the random and systematic errors of the calibration process. However, because of relatively large heating effects, the above values should not be relied upon to this accuracy unless the conditions in use duplicate those stated in this report.

For the Director
by

F. L. Hermach

F. L. Hermach, Chief
Electrical Instruments Section
Electricity Division
Institute for Basic Standards

211.03/187060
Order No. BL-15303
December 20, 1965

U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS
INSTITUTE FOR BASIC STANDARDS
BOULDER, COLORADO 80301

REPORT OF CALIBRATION
CAPACITANCE STANDARD
No. 117665

Submitted by:

Tung-Sol Electric, Incorporated
Bloomfield, New Jersey

In order to make this capacitor compatible for measurement on NBS instrumentation, it was necessary to utilize a 12-inch length of coaxial cable and an adaptor from the female UHF connectors to a Western Electric Type 358-A connector. This adapting equipment was connected to terminals "F" and "L" of the main capacitor as required to complete the calibration. The stated accuracy of the measurements includes any errors contributed by the use of the adapting equipment.

The direct capacitance values, given in the table, were obtained at 465 kHz under ambient conditions of approximately 23° C and 40 percent relative humidity.

Capacitor Termination	Direct Capacitance picofarads
H to F with L open	8.66 ± 0.03
H to L, cap on F	3.308 ± 0.010
H to L, 100 unit on F	0.619 ± 0.002
H to L, 1000 unit on F	0.0764 ± 0.0003
H to L, 10000 unit on F	0.00748 ± 0.00007
H to L, 1 unit on F	0.1060 ± 0.0004
H to L, 2 unit on F	0.2219 ± 0.0007
H to L, 3 unit on F	0.3403 ± 0.0011
H to L, 4 unit on F	0.4390 ± 0.0013

For the Director,
Institute for Basic Standards

K. R. Wendt, Chief
High Frequency Calibration Services
Radio Standards Engineering Division
Radio Standards Laboratory

Test No. 802875
Date: January 7, 1966
Reference: P. O. No. BL-15304

Tung-Sol Electric, Inc. Electron Tube Division

Bloomfield Measurements Dept.

Measurements Calibration and Standardization Policies

Issue Date: March 5, 1964
Still in effect 4-22-65
DB.

A. Primary Standards

1. Voltage

Two Weston standard cells, model 4.
Calibrated annually by Weston (traceable to NBS)

2. Resistance

One L & N, type K-2 potentiometer
One L & N volt box, type 7591 " " "
One L & N shunt box, type 4390 " " "
Two T-S shunt boxes " " "
All above calibrated annually by NBS.

3. Capacitance

Eleven standard capacitors, from apprx. .008 mf to 25 pf.
Calibrated annually by NBS.

4. Frequency

Beckman/Berkeley WWV receiver, model 905.
Calibrated at each use-at least monthly-against WWV (NBS).

B. Secondary (Working) Standards

1. Standard Meter Cart (Mobile)

a. DC voltage and current

Four Weston model 1 meters. (1/4 %.).
Calibrated monthly against the primary standards.

b. AC voltage

Two Weston model 341 meters. (1/4 %).
Calibrated monthly against the primary standards.

2. AC current

Weston model 622 thermocouple meter. (1/4 %).
Calibrated monthly against the primary standards.

3. Resistance

L & N Wheatstone Bridge, model 5305, type S-2 (.1%).
Calibrated monthly against the primary standards.

4. Capacitance

RCA capacitance Bridge, model 731 CM (1%).
Calibrated MONTHLY against the primary standards.

5. Frequency

Beckman/Berkeley Counter, model 7370, and Transfer Oscillator, model 7580. (1 part in 10^6).
Calibrated monthly against the primary standards.

6. R.F. Power

Hewlett-Packard Calorimetric Power meter, model 434A (5%).
Calibrated monthly against the primary standards.

C. Measurements Test Equipment Calibration

All test equipment is calibrated against the working standards on a continuous round-robin basis, (coming to about four times a year). As soon as a complete calibration of all equipment has been finished, another round of calibrations is started, etc.

A separate calibration data sheet is maintained for each meter, showing dates and results of calibration.

JG/em

J. Ginsberg

Supervisor of Engineering Services.

ELECTRON TUBE DIVISION — BLOOMFIELD MEASUREMENTS DEPT.

EQUESTED BY Aeroprojects Inc. P.O A 20069

ESTED PER SPEC MIL E1/1121A (PG.1) (PG.2) (PG.3)

DATA SHEET

IRIDGE No.

MOUNT TUBES 20

SPECIAL FEATURES Heater Cycling Life Test Ultrasonically Welded 1080 WB

LOT

PROD. DATE

DATE RECEIVED

DATE COMPLETED 3-10-64

est / ating / ommer-cial mits / ine & age of pec. / be No.	IHK+ Heater Cathode Leakage Sec. 1/2 25 Max µAdc	IHK- Heater Cathode Leakage Sec 1/2 25 Max µAdc	See Note 2 at bottom	IHK+ Heater Cathode Leakage Sec 1/2 50 Max µAdc	IHK- Heater Cathode Leakage Sec. 1/2 50 Max µAdc
	4.10.15	4.10.15		4.11.4	4.11.4
	Pre-Heater Cycling Test Data.			Post-Heater Cycling Test Data.	
77	3/5	3/6	G P K Short	2.1/2.2	1.6/1.8
80	4/8	4/5	G_2K_2 Short	2.2/1.8	1.8/1.5
83	4/7	3/8	Open Sec 2	2.0/1.4	1.4/0.8
86	3/4	3/3	G_1K_1 Short	1.4/1.5	1.8/0.8
89	4/4	5/5	G_2K_2 Short	2.8/3.2	1.3/.2
93	2/4	4/4	G_1K_1 Short	1.7/1.6	0.8/0.9
94	3/4	3/4	G_2P_2 Short	1.8/1.4	0.8/1.0
95	2/4	3/4	High Ic	1.7/1.8	0.9/0.8
102	3/4	3/4	G_2P_2 Short	1.8/2.7	1.2/1.2
103	3/4	3/5	High Ic	3.2/2.3	1.3/.4
105	3/4	5/4	G_2P_2 Short	3.4/3.8	2.0/.7
111	3/4	4/4	High Ib	1.7/1.4	0.9/0.8
126	5/9	5/9	G_2K_2 Short	5.4/5.7	2.5/2.5
131	5/5	4/4	$G_2P_2K_2$ Short	2.5/1.6	1.6/1.3
132	4/4	4/3	G_2K_2 Short	2.2/2.6	1.4/1.1
134	4/4	4/4	High Ic	3.8/3.5	1.0/1.3
135	3/3	4/4	G_1K_1 Short	2.4/2.2	1.5/2.0
138	3/4	5/4	G_2K_2 Short	1.8/1.8	2.0/1.5
140	3/3	5/5	G_2K_2 Short	1.7/1.4	1.2/1.3
142	3/4	4/4	G_2K_2 & G_1K_1 Short	1.8/1.6	1.5/1.4

ntrol nits

Test Witnessed by USAF Com. Pgm. Eng.

Note ① All tubes meet life test endpoints

② Tubes test this test had heater cathode which would not [illegible] Heater Cathode Evaluation

erage

st By

TYPE

ELECTRON TUBE DIVISION — BLOOMFIELD MEASUREMENTS DEPT.

TYPE 6080WB

REQUESTED BY Ace Projects Inc. P.O A20069 — LOT

TESTED PER SPEC MIL-E-1/1181A (PG.1) (PG.2) (PG.3) — PROD. DATE

DATA SHEET

BRIDGE No. — DATE RECEIVED

AMOUNT TUBES 15 — SPECIAL FEATURES Shock Test per 4.9.20.5 Ultrasonically Welded Tube Type 6080WB — DATE COMPLETED 3-17-66

Test	I_{b_1}	I_{b_2}	I_c	I_f	S_{m_1}	S_{m_2}	I_{HK+}	I_{HK-}	Shorts	E_p	E_p	E_p		E_p	E_p	E_p	I_{HK+}	I_{HK-}	ΔS_m	I_c
Rating	Plate Current		Grid Current	Heater Current	Transconductance		Heater to Cathode Leakage		Shorts	V_{1b} (2)	V_{1b} (2)	V_{1b} (2)		V_{1b} (2)	V_{1b} (2)	V_{1b} (2)	Heater to Cathode Leakage		(t)	Grid Current
Commercial limits	100 Min 150 Max		−1.0 Max.	2.35 2.65	6000 Min 8200 Max		Sec 1/2 25 Max	Sec 1/2 25 Max	Noisy	X Pos 500 Max	Y Pos 500 Max	Z Pos 500 Max		X Pos. 500 Max.	Y Pos. 500 Max	Z Pos 500 Max	Sec. 1/2 50 Max.	Sec. 1/2 50 Max.	Sec 1/2 10 Max	−1.5 Max
	mAdc	mAdc	μAdc	A	μmhos	μmhos	μAdc	μAdc		mVac	mVac	mVac		mVac	mVac	mVac	μAdc	μAdc	%	μAdc
Line & Page of Spec.	4.10.4.1	4.10.4.1	4.10.6.1	4.10.8	4.10.9	4.10.9	4.10.15	4.10.15	4.7.5	Part 2 Page 2	Part 2 Page 2	Part 2 Page 2		Part 3 Page 3	Part 3 Page 3	Part 3 Page 3	Part 3 Page 3 4.10.15	Part 3 Page 3 4.10.15	Part 3 Page 3	Part 3 Page 3 4.10.6.1
Tube No.	Pre Shock Test Data													Post Shock Test Data						
1 109	116	115	0.5	2.4	6440	6940	0/0	0/0	O.K	300	110	100		380	140	120	1.6/1.8	8.0/4.0	4.2/.87	0.9
2 110	111	112	0.8	2.6	7170	7040	4/4	4/3	O.K	100	120	90		70	80	50	2.8/3.4	4.0/2.4	28/2.0	0.9
3 113	113	112	0.4	2.5	7090	7150	0/0	0/0	O.K	100	100	60		113	160	70	1.4/1.8	2.2/5.2	1.4/0	0.6
4 114	118	117	0.5	2.5	7090	6650	5/4	3/3	O.K	150	100	100		Open Filament & Cracked Stem					—	—
5 115	112	111	0.4	2.5	7360	7240	0/0	4/3	O.K	60	70	50		70	100	45	1.3/2.0	2.4/1.8	1.8/0	0.7
6 116	112	112	0.5	2.5	7200	6850	2/2	3/3	O.K	150	200	120		180	(1000)	65	1.2/2.0	3.5/2.2	.42/2.5	0.9
7 117	116	113	0.4	2.4	6980	6840	4/4	3/3	O.K	200	180	110		(1000)	(1000)	(1000)	1.0/1.4	1.8/6.0	2.0/.39	0.6
8 118	111	114	1.0	2.5	7150	6550	5/4	4/4	O.K	210	180	70		Grid Cathode Short Sec 2 & Open Filament To Air, Cracked Stem						
9 119	115	110	0.6	2.6	6820	7070	5/5	4/4	O.K	120	100	60							—	—
10 120	111	110	0.8	2.5	7130	6850	0/0	4/4	O.K	100	70	60		120	60	70	1.4/1.8	0.9/2.0	0.7/1.9	0.9
11 121	112	117	0.8	2.5	7300	7070	4/5	4/4	O.K	150	100	100		190	140	500	3.0/2.5	2.2/3.0	.27/2.0	1.0
12 122	114	114	0.6	2.5	6810	6600	0/0	3/3	O.K	120	120	100		140	120	(1200)	1.0/1.4	2.2/2.0	.97/2.1	1.1
13 123	113	111	0.5	2.5	7000	7010	4/4	5/5	O.K	100	80	30		110	(1000)	50	2.2/2.8	3.3/3.4	.12/1.7	0.9
14 124	116	111	0.5	2.5	7160	7130	0/0	5/5	O.K	250	200	180		(1000)	(1000)	(700)	1.6/1.2	2.8/2.5	0/2.7	1.1
15 125	116	111	0.9	2.6	7300	7190	5/5	5/5	O.K	190	100	40		250	90	90	1.4/2.3	1.5/2.2	0.9/2.1	0.9
16																				
17																				
18																				
19	Note	Tube No 114 Failed due to open filament & Cracked Stem												Tube No 123 Failed due to High Ep in the Y Position						
20		Tube No 116 Failed due to High Ep in the Y Pos												Tube No 124 Failed due to High Ep in the X, Y & Z Po						
Control Items		Tube No 117 Failed due to High Ep in the X, Y, & Z positions Tube No 118 Failed due to Grid to Cathode Short Sec. 2 & Open Fil To												Test Witnessed by USAF Comm						
Average		Tube No 119 Failed due to Tube going to Air, Cracked Stem												Production Engineer						
Test H-		Tube No 122 Failed due to High Ep in the Z Position												M. Yamamoto 4-12-66						

TUNG-SOL ELECTRIC INC. **CHATHAM ELECTRONICS DIVISION** **LIVINGSTON, N. J.**

TITLE:	SPEC. NO:	PARA NO:	DATE:
VIBRATION FATIGUE	MIL-E-1/1121A		24MAR66
TYPE:	**LOT NO:**	**TR. NO:**	**PAGE NO:**
6080 W/B	—	2344	—

ITEM NO.	
1	
2	TWENTY (20) TUBES MARKED: 127, 128, 130, 133,
3	136, 137, 139, 141, 143, 144, 145, 147, 148,
4	149, 150, 151, 152, 153, 154, 155 WERE
5	
6	SUBJECTED TO THE FATIGUE VIBRATION CONDITIONS
7	SPECIFIED IN THE ABOVE CITED SPECIFICATION.
8	
9	
10	
11	AT THE CONCLUSION OF THE NINETY SIX
12	FATIGUE VIBRATION EXPOSURE THE FOLLOWING
13	DEFECTS WERE DISCLOSED:
14	
15	
16	TUBE 141 - AIR
17	148 - AIR
18	151 - OPEN HEATER
19	153 - OPEN HEATER
20	
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SIGNATURES: H H Burd — Leonard Mendelsohn, DEPS QAR — witnessed & recorded on DSA FORMS

TITLES:

ELECTRON TUBE DIVISION — BLOOMFIELD MEASUREMENTS DEPT.

TYPE 6080WB

REQUESTED BY Aerospace Inc P.O. A20069

TESTED PER SPEC. Mil-E/1124A (PG.1) (PG.2) (PG.3)

DATA SHEET

LOT

PROD. DATE

BRIDGE No.

SPECIAL FEATURES Fatigue Test Part 3 Page 3 ISS. Ultrasonically Welded Tube Type 6080WB

DATE RECEIVED 3-11-66

AMOUNT TUBES 20

DATE COMPLETED 4-11-66

Test	Ib1	Ib2	Ic	If	Sm1	Sm2	IHK+	IHK-	Ep	Ep	Ep	Shorts	Ep	Ep	Ep	IHK+	IHK-	ΔSm	Ic
Rating	Plate Current		Grid Current	Heater Current	Trans Conductance		Heater-Cathode Leakage		V.b. (2)	V.b. (2)	V.b. (2)	& Cont.	V.b. (2)	V.b. (2)	V.b. (2)	Heater-Cathode Leakage		(+)	Grid Current
Commercial Limits	100 Min 150 Max mAdc	mAdc	-1.0 Max. μAdc	2.35 2.65 A	6000 8200 μmhos	Min. Max. μmhos	Sec. 1/2 25 Max. μAdc	Sec. 1/2 25 Max. μAdc	X Pos. 500 Max. mVac	Y Pos 500 Max. mVac	Z Pos. 500 Max. mVac	—	X Pos. 500 Max. mVac	Y Pos. 500 Max. mVac	Z Pos. 500 Max. mVac	Sec. 1/2 50 Max. μAdc	Sec. 1/2 50 Max. μAdc	Sec 1/2 10 Max %	-1.5 Max. μAdc
Line & Page of Spec.	4.10.4.1	4.10.4.1	4.10.6.1	4.10.8	4.10.9	4.10.9	4.10.15	4.10.15	Part 2 Page 2	Part 2 Page 2	Part 2 Page 2	4.7.4	Part 3 Page 3	Part 3 Page 3	Part 3 Page 3	Part 3 Page 3 4.10.15	Part 3 Page 3 4.10.15	Part 3 Page 3	Part 3 Page 3 4.10.6.1
Tube No.			Pre Vibration Fatigue Test Data										Post Fatigue Test Data						
1 127	118	122	0.5	2.5	6760	6800	0/0	6/6	(700)	(900)	100	O.K	(800)	(800)	(1000)	2.5/2.2	1.4/1.4	.75/1.91	1.20
2 128	113	112	0.8	2.5	7130	6920	0/0	5/7	120	60	70	O.K	250	300	100	1.4/3.2	1.0/3.4	4.7/(6.8)	(2.40)
3 130	112	112	0.5	2.4	7030	6910	0/0	0/0	150	130	110	O.K	275	(600)	400	1.9/1.6	1.6/1.9	4.4/(38.4)	(1.60)
4 133	110	105	0.9	2.5	7020	6760	0/0	0/0	100	45	80	O.K	160	100	400	1.2/2.0	1.2/1.0	3.0/(5.9)	1.15
5 136	115	119	0.9	2.5	7080	6800	5/5	5/0	90	230	70	O.K	250	400	(1000)	6.0/3.2	3.6/3.2	1.9/1.45	1.25
6 137	109	107	0.7	2.5	7360	7200	3/3	3/3	50	45	55	O.K	Open	Heater Intermittent		—	—	—	—
7 139	113	110	1.0	2.5	7050	7150	0/0	0/0	250	75	50	O.K	Intermittent Open			Sec. 2 K, Tab Top	—	—	—
8 141	117	115	1.0	2.4	7110	6790	0/5	4/4	300	110	40	O.K	Air	Cracked Stem		—	—	—	—
9 143	125	118	0.0	2.5	6710	7090	5/5	5/5	(4000)	(3500)	(4000)	OK	Intermittent Open P, K, G, Short			—	—	—	—
10 144	115	114	0.9	2.6	7060	7100	4/4	4/4	(900)	(900)	(100)	O.K	Intermittent K, G, P, Short			—	—	—	—
11 145	112	119	0.5	2.5	7020	6750	5/5	4/4	100	90	45	O.K	(800)	150	100	2.8/3.7	2.2/2.2	4.3/2.3	1.32
12 147	106	106	0.9	2.5	7180	6660	5/5	5/5	20	25	20	O.K	(1000)	(1000)	275	2.2/2.9	1.7/1.7	1.7/(66.4)	1.50
13 148	111	108	0.6	2.5	7200	7000	0/0	0/0	210	260	100	O.K	Air	Cracked Seal		—	—	—	—
14 149	112	114	0.5	2.5	7070	6960	5/5	3/3	140	(800)	100	O.K	K, G, Short			—	—	—	—
15 150	119	115	0.4	2.5	7040	6990	5/5	0/0	(1000)	(1000)	80	O.K	350	300	200	1.6/1.7	1.3/1.1		0.63
16 151	114	112	0.6	2.5	7190	7050	0/0	4/4	100	100	65	O.K	Open	Filament & Other Welds Broken					—
17 152	113	114	0.5	2.5	7290	6850	5/5	5/6	(900)	80	200	O.K	300	100	40	3.8/4.8	(76.0)/85.3	1.9/5.2	(52.0)
18 153	111	114	1.0	2.6	7020	6800	4/4	4/4	100	60	40	O.K	Open	Filament Tabs		—	—	—	—
19 154	118	115	0.8	26	7200	7100	6/6	5/5	(3500)	(1000)	60	O.K	Intermittent G, K, Short			—	—	—	—
20 155	109	113	0.5	2.5	7190	7170	3/3	3/3	160	70	55	OK	Open Sec. 2 K, Tab bottom			—	—	—	—
Control Limits	(1) Note Tube No 127, 143, 144, 149, 150, 152 & 154 had high Ep Readings prior												Test Witnessed by U.S.A.E. Com, Production Eng.						
Average	to Fatigue.																		
Test By	(2) 19 out of 20 Tubes failed to meet Fatigue end points										M. Yarmowsky 4-12-66								

BB-20

864 4B

TYPE

REQUESTED BY Aerojet Electronic Systems Inc P.O. A20369

TESTED PER SPEC MIL-E-4/112A (PG.1) ——— (PG.2) ——— (PG.3) ———

BRIDGE No. ———

AMOUNT TUBES 20

DATA SHEET

SPECIAL FEATURES Life Test 2000 hrs, Part 3 pages 7, 5, 3 Ultrasonically Welded Tube Type 6080WB

LOT 16000

PROD. DATE ———

DATE RECEIVED 3-10-6

DATE COMPLETED 5-22-6

Test	I_c	S_{c2}/S_{c3}	S_{c1}/S_{c3}	$\Delta f S_{c1}$	S_{c2}/S_{c3}	S_{c2}/S_{c3}	$\Delta f S_{c2}$	I_{H-K}	I_{H-K}	I_f	$\Delta f S_{c1}$	$\Delta f S_{c2}$	Rp-All	Rp-All	Rp-All	Rp-All		Time of Rem	
Rating	Grid Current	Sec 1 Transc	Sec 1 Inductance	Sec 1	Sec 2 Transc	Sec 2 Conduct	Sec 2	Heater Leakage	Cathode Leakage	Heater Current	Sec 1	Sec 2	Insulation of Electrodes		Insulation of Electrodes			Life	
Commercial Test Limits	-5 Max μAdc	— μmhos	— μmhos	10% Max.	— μmhos	— μmhos	10% Max	Sec 1/2 25 Max μAdc	Sec 1/2 25 Max μAdc	2.35 2.75 A	15% Max	15% Max	Sec 1 100 Min MegΩ	Sec 1 100 Min MegΩ	Sec 2 100 Min MegΩ	Sec 2 100 Min MegΩ		Hours	
Line & Page of Spec.	4.11.4																		
Tube No.																			
76	0.50	7160	7080	1.20	7000	6950	0.80	6/4	5/5	2.60	0	0	12500	36600	14700	32500		0	
	1.15	7150	7120	0.50	7130	7090	0.60	8.2/4.0	2.0/1.6	2.49	1.40	1.60	62500	93600	150000	250000		100	
	1.25	7170	7130	0.60	7140	7100	0.60	3.5/4.1	6.0/9.0	2.51	1.40	2.00	100000	125000	100000	167000		200	
	1.02	7160	7130	0.50	7140	7110	0.60	2.2/4.0	2.4/2.0	2.50	0	2.00	7140	125000	11140	187000		280	
	1.65	7120	7100	0.29	7190	7170	0.28	5.8/4.0	2.1/3.3	2.50	5.60	2.70	100000	83400	100000	93600		400	
	0.42	7130	7100	0.43	7200	7170	0.42	3.4/2.1	2.5/3.0	2.51	0.42	2.80	100000	167000	100000	150000		500	
	0.54	7270	7150	1.60	7270	7200	0.10	2.2/1.9	0.5/1.1	2.52	1.80	3.80	100000	250000	100000	216000		760	
	0.40	7200	7130	0.91	7260	7240	0.27	3.0/3.9	1.8/4.3	2.52	0.55	3.70	100000	200000	100000	187000		1020	
	0.75	7220	7140	1.20	7290	7260	0.41	2.5/3.9	1.6/2.8	2.52	0.83	4.10	100000	300000	100000	167000		1500	
	0.80	7160	7110	0.69	7250	7220	0.41	2.5/2.8	1.2/2.0	2.50	0	3.60	100000	216000	100000	187000		2000	
78	0.50	7080	7000	1.20	7060	7000	0.90	0.0/0.0	3.0/4.0	2.50	0	0	5000	79000	25000	46900		0	
	0.70	7160	7110	0.70	7010	6970	0.58	9.4/5.0	2.4/3.8	2.40	1.10	0.71	100000	31700	100000	16700		100	
	1.05	7090	7050	0.60	7090	7060	0.50	3.8/5.5	3.5/4.4	2.42	0.14	0.42	100000	2160	100000	38400		200	
	0.78	7130	7080	0.71	7130	7100	0.43	3.2/3.3	2.7/2.4	2.43	0.70	0.99	100000	4290	4550	216000		280	
	0.42	7190	7140	0.70	7100	7080	0.29	3.6/3.8	2.8/3.2	2.44	1.60	0.56	100000	4050	45500	42900		400	
	0.30	7160	7110	0.70	7100	7090	0.15	3.6/3.6	2.0/2.9	2.43	1.10	0.56	100000	12500	100000	15000		500	
	0.52	7220	7150	0.97	7120	7070	0.71	1.2/1.8	1.4/1.5	2.44	1.90	0.42	100000	18700	100000	30000		760	
	0.25	7280	7200	1.10	6950	6920	0.29	2.8/3.0	1.8/2.8	2.43	2.80	1.50	100000	16700	100000	30000		1020	
	2.44	7250	7150	1.40	7050	7020	0.43	3.4/5.0	2.5/3.0	2.42	2.40	0.14	50000	3720	9000	3750		1500	
B421	(5.70)	7230	7140	1.20	7030	6940	1.30	3.2/4.6	1.8/2.0	2.42	2.10	0.43	100000	18700	100000	4441		2000	High
Control Limits																			
Average																			
Test By																			

Test Witnessed by
Arthur N. Kiedaisch Jr
DCAS - GAR
22 JUNE 66

6080W

REQUESTED BY Accelerojects Inc P.O A20269

TESTER SPEC MIL-E-1/1121A (PG.1) (PG.2) (PG.3)

DATA SHEET

LOT

PROD. DATE

DATE RECEIVED 3-10-64

DATE COMPLETED 5-22-64

SHOP No.

AMOUNT TUBES 20

SPECIAL FEATURES Life Test 2000 hrs, Part 3 Page 8 T.S.J. Ultrasonically Welded Tube Type 6080WB

Test	I_c	S_m @ 6.3	S_m @ 5.7	$\Delta f S_m$	S_m @ 6.3	S_m @ 5.7	$\Delta f S_m$	I_{H-K}	I_{H-K}	I_f	$\Delta f S_m$	$\Delta f S_m$	Rq-All	Rq-All	Rq-All	Rp-All	Time of Removal
Rating	Grid Current	Sec 1 Transconductance	Sec 1 Conductance	Sec 1	Sec 2 Transconductance	Sec 2 Conductance	Sec 2	Heater to Cathode Leakage	Cathode Leakage	Heater Current	Sec 1	Sec 2	Insulation Resistance of Electrodes	Insulation Resistance of Electrodes	Insulation Resistance of Electrodes	Insulation Resistance of Electrodes	Life
Commercial / 6080W Limits	-5 Max μAdc	— μAdc	— μAdc	10% Max.	— μmhos	— μmhos	10% Max	Sec 1/2 25 Max μAdc	Sec. 1/2 25 Max μAdc	2.35 2.75 A	15% Max	15% Max	Sec 1 100 Min MegΩ	Sec 1 100 Min MegΩ	Sec. 2 100 Min MegΩ	Sec. 2 100. Min MegΩ	Hours
Line & Page of Spec	Y 11.4	→														→	
Tube No.																	
79	0.70	6580	6520	1.00	7080	6960	1.70	4.0/4.0	6.0/8.0	2.50	0	0	1220	39500	13200	216000	0
	1.50	6870	6830	0.60	7140	7080	0.85	8.2/9.8	2.6/6.7	2.40	4.40	0.84	100000	60000	100000	15000	100
	1.52	6850	6810	0.60	7200	7150	0.70	7.5/9.2	5.2/5.8	2.42	4.10	1.70	100000	10700	100000	6250	200
	0.50	7000	6980	0.29	7200	7170	0.42	4.8/4.3	3.7/3.2	2.42	6.40	1.70	100000	7500	100000	68200	280
	0.54	6990	6970	0.29	7210	7180	0.42	4.4/4.8	2.8/(88)	2.42	6.20	1.80	625	30000	100000	20000	400 H.K-Leak
	0.46	7040	7020	0.29	7210	7170	0.42	3.4/2.8	2.4/(60)	2.43	6.90	1.80	100000	37500	25000	1500	500 H.K-Leak
	0.58	7000	6960	0.97	7230	7180	0.70	3.2/3.8	2.7/(64)	2.43	6.40	2.10	100000	150000	100000	20000	760 H.K-Leak
	0.30	7040	7020	0.28	7240	7220	0.28	2.2/2.2	2.2/(3.4)	2.43	6.90	2.70	100000	30000	100000	11500	1020
	1.20	7020	6960	0.85	7320	7250	0.95	3.4/6.0	1.5/(59)	2.43	6.20	3.40	100000	150000	100000	30000	1500 H.K-Leak
	2.80	6960	6900	0.86	7210	7250	0.82	3.8/5.5	1.7/(61)	2.42	5.70	3.20	100000	150000	100000	25000	2000 H.K-Leak
81	0.70	7030	6850	2.60	6560	6440	1.80	0/0	0/0.4	2.50	0	0	12300	31900	14300	300000	0
	1.04	7100	7060	0.60	6590	6540	0.80	2.8/5.6	4.0/2.0	2.42	0.99	0.45	100000	100000	100000	37500	100
	1.15	7140	7100	0.60	6590	6560	0.50	3.8/5.4	2.7/4.0	2.42	1.50	0.45	100000	21600	100000	18700	200
	0.58	7180	7140	0.56	6600	6580	0.31	3.6/2.8	2.4/2.6	2.42	2.10	0.60	100000	100000	100000	100000	280
	0.42	7140	7100	0.42	6610	6630	0.31	3.4/4.7	2.8/3.4	2.42	1.50	1.40	100000	18700	100000	21600	400
	0.37	7220	7200	0.28	6650	6630	0.31	2.5/3.3	2.6/3.0	2.42	2.20	1.40	100000	25000	100000	18700	500
	0.64	7210	7170	0.56	6690	6660	0.45	2.8/4.0	3.2/4.0	2.43	2.60	2.10	100000	33400	100000	42900	760
	0.50	7270	7220	0.69	6770	6710	0.88	1.6/2.0	1.4/2.0	2.42	3.40	3.20	100000	21600	100000	30000	1020
	0.25	7300	7250	0.57	6800	6720	1.20	4.0/3.8	1.8/4.2	2.42	3.80	3.20	100000	71400	100000	12500	1500
	0.18	7300	7240	0.82	6770	6760	1.50	4.8/4.0	1.4/3.2	2.42	3.80	3.20	100000	6820	100000	18700	2000
Control Limits																	
Average																	
Test By																	

B-22

TYPE

NO **TUNG-SOL** ELECTRIC INC PE 6050u

ELECTRON TUBE DIVISION BLOOMFIELD MEASUREMENTS DEPT.

REQUESTED BY Aerotojects Inc P.O A20065 LOT

TESTED PER SPEC Mil-E-1/1121A (PG.1) (PG.2) (PG.3) # DATA SHEET PROD. DATE

DDCP No. DATE RECEIVED 3-10-66

AMOUNT TUBES 20 SPECIAL FEATURES Life Test 2000 hrs, Part 3 page 8 T.S. DATE COMPLETED 5-22-66

Ultrasonically Welded Tube Type 6080WB

Test	Ic	Sm@6.3	Sm@5.7	Δ of Sm	Sm@6.3	Sm@5.7	Δ of Sm	IH-K Heater Cathode	IH-K Heater Cathode	If	ΔfSm	ΔfSm	Rg-All Insulation by of Electrodes	Rg-Al Insulation by of Electrodes	Rg-All Insulation by of Electrodes	Rp-Al Insulation by of Electrodes		Time of Remove
Rating	Grid Current	Sec 1 Transconductance	Sec 1 Conductance	Sec 1	Sec 2 Transconductance	Sec 2 Conductance	Sec 2	Heater Cathode Leakage	Heater Cathode Leakage	Heater Current	Sec 1	Sec 2	Sec 1	Sec 1	Sec 2	Sec 2		Life
Commercial Limits	-5 Max μAdc	μmhos	μmhos	10% Max.	μmhos	μmhos	10% Max	Sec 1/2 25 Max μAdc	Sec 1/2 25 Max μAdc	2.35 2.75 A	15% Max	15% Max	100 Min MegΩ	100 Min MegΩ	100 Min MegΩ	100 Min MegΩ		Hours
Line & Page of Spec.	H 11.4																	
Tube No.																		
82	0.20	6890	6710	2.70	6470	6300	0.76	0/0	5.0/5.0	2.50	0	0	15200	36600	83300	18700		0
	0.98	6830	6760	1.10	6490	6440	0.78	3.8/4.1	4.7/3.5	2.42	0.88	0.30	83300	216000	41700	125000		100
	0.75	6820	6750	1.10	6400	6350	0.80	8.0/2.2	4.5/3.3	2.44	1.00	1.10	100000	16700	100000	18700		200
	0.35	6780	6760	0.30	6370	6350	0.32	1.7/5.2	2.9/3.2	2.46	1.60	1.60	100000	216000	100000	167000		280
	0.38	6760	6700	0.89	6520	6500	0.31	6.8/2.9	4.4/3.4	2.46	1.00	0.77	100000	3340	100000	30000		400
	0.25	6700	6650	0.75	6580	6560	0.31	5.8/3.2	3.8/2.9	2.46	2.80	1.70	100000	31900	100000	18700		500
	0.48	6730	6680	0.75	6550	6500	0.77	2.8/3.5	2.4/3.5	2.45	2.30	1.20	100000	83300	100000	125000		760
	0.36	6770	6650	1.80	6540	6460	1.20	2.4/1.4	2.2/1.8	2.46	1.70	1.10	100000	300000	100000	18700		1020
	0.40	7000	6830	2.40	6630	6450	2.70	4.2/3.8	3.0/3.0	2.42	1.60	2.50	100000	150000	100000	9360		1500
	0.38	7010	6970	0.57	6510	6440	1.10	4.0/3.8	4.5/4.6	2.38	1.70	0.62	100000	150000	100000	15000		2000
84	0.50	7130	7030	1.40	6440	6840	1.40	0/0	3.0/3.0	2.50	0	0	10000	18700	7140	15000		0
	1.29	7150	7110	0.56	7050	7010	0.57	5.5/4.7	3.6/4.5	2.42	0.28	1.60	100000	107000	100000	16700		100
	1.35	7220	7100	1.70	7170	7050	1.70	5.4/5.7	5.7/4.4	2.44	1.30	3.30	100000	8340	100000	3750		200
	0.48	7210	7190	0.28	7080	7040	0.57	3.6/3.8	3.0/3.1	2.43	1.10	2.00	100000	3060	100000	883		280
	0.45	7210	7180	0.42	7160	7120	0.56	3.5/3.9	2.6/4.2	2.44	1.10	3.20	100000	13600	1110	1670		400
	0.45	7260	7230	0.42	7140	7100	0.57	3.3/3.9	2.9/3.5	2.44	1.80	2.90	100000	16700	100000	18700		500
	0.68	7290	7270	0.28	7210	7180	0.42	3.6/4.0	2.8/3.8	2.44	2.20	3.90	100000	8830	29410	2160		760
	0.32	7270	7250	0.28	7200	7180	0.28	3.2/2.9	1.8/3.1	2.44	2.00	3.70	100000	3840	100000	3000		1020
	0.28	7240	7210	0.41	7240	7220	0.28	4.8/6.0	3.2/3.2	2.44	1.50	4.30	100000	1690	10000	2160		1500
	0.22	7280	7250	0.41	7230	7180	0.69	4.8/6.2	2.8/3.4	2.43	2.10	4.20	20000	4550	3330	2500		2000
Control Limits																		
Average																		
Typ																		

B-23

TYPE

NO

TUNG-SOL ELECTRIC INC

ELECTRON TUBE DIVISION — BLOOMFIELD MEASUREMENTS DEPT.

TYPE 6080

CUST. Aerojet Inc P.O A20069

TEST SPEC MIL-E-1/1121M (PG.1) (PG.2) (PG.3)

DATA SHEET

LOT

PROD. DATE

DATE RECEIVED 3-10-66

DATE COMPLETED 5-22-66

P

NO. 20

SPECIAL FEATURES Life Test 2000hrs, Part 3 page 8 T.S.J. Ultrasonically Welded Tube Type 6080WB

Test / Rating	I_c Grid Current	S_m@6.3 Sec1 Transconductance	S_m@5.7 Sec1 Transconductance	ΔS_m Sec1	S_m@6.3 Sec2 Transconductance	S_m@5.7 Sec2 Transconductance	ΔS_m Sec2	I_{H-K} Heater to Cathode Leakage	I_{H-K} Heater to Cathode Leakage	I_f Heater Current	ΔI_{fSm} Sec1	ΔI_{fSm} Sec2	Rg-All Insulation between Electrodes Sec1	Rg-All Insulation between Electrodes Sec1	Rg-All Insulation between Electrodes Sec2	Rg-All Insulation between Electrodes Sec2	Time of Removal Life
Commercial 10004 Limits	-5 Max	—	—	10% Max.	—	—	10% Max	Sec 1/2 25 Max	Sec. 1/2 25 Max	2.35 2.75	15% Max	15% Max	Sec 1 100 Min	Sec 1 100 Min	Sec. 2 100 Min	Sec. 2 100. Min	Hours
	μAdc	μMhos	μMhos		μMhos	μMhos		μAdc	μAdc	A			MegΩ	MegΩ	MegΩ	MegΩ	
Line & Page of Spec	411.4																
Tube No.																	
85	0.50	7220	7160	0.84	6470	6430	0.62	0/0	6.0/5.0	2.5	0	0	455000	15000	12500	21600	0
	1.10	7180	7140	0.56	6570	6520	0.77	6.0/5.1	3.2/3.2	2.46	0.56	1.50	100000	10000	100000	21600	100
	1.12	7230	7190	0.56	6580	6540	0.61	8.4/5.6	5.2/4.0	2.48	0.13	1.70	100000	1250	100000	2500	200
	0.70	7350	7270	1.10	6550	6500	0.77	9.2/6.2	5.8/5.0	2.48	1.80	1.20	100000	4290	100000	5460	280
	0.54	7240	7200	0.56	6530	6500	0.46	3.7/3.5	3.3/4.6	2.48	0.27	0.92	100000	2500	100000	3340	400
	0.58	7310	7270	0.55	6610	6570	0.61	4.2/3.8	3.8/4.8	2.48	1.20	2.10	100000	2160	100000	2500	500
	0.66	7190	7170	0.42	6440	6420	0.32	8.6/6.4	5.0/4.2	2.49	0.42	0.47	100000	2500	100000	2500	760
	0.35	7180	7160	0.28	6600	6560	0.61	5.7/4.2	2.9/3.0	2.50	0.56	2.00	83300	313	100000	6000	1020
	0.26	7200	7170	0.42	6400	6370	0.47	8.4/7.0	3.5/4.2	2.48	0.28	1.10	100000	577	3850	3580	1500
	0.16	7290	7250	0.55	6480	6440	0.62	7.4/7.8	3.4/3.4	2.48	0.97	0.15	71400	834	2630	750	2000
87	0.60	7310	7260	0.69	6790	6650	2.10	4.0/0	0/0	2.50	0	0	11100	34900	15600	32600	0
	1.38	7330	7280	0.69	6850	6810	0.59	3.5/3.2	2.2/2.2	2.48	0.27	0.88	100000	216000	100000	53600	100
	1.58	7340	7300	0.55	6920	6900	0.29	9.4/9.5	4.2/5.2	2.48	0.41	1.90	100000	25000	100000	7500	200
	0.88	7020	7000	0.29	7050	7020	0.43	4.2/6.0	2.8/4.2	2.48	3.98	3.80	100000	34100	100000	30000	280
	0.72	7320	7300	0.28	7020	7000	0.29	8.4/9.4	3.2/4.0	2.48	0.13	3.40	100000	18700	100000	3000	400
	0.60	7310	7280	0.42	7000	6980	0.29	6.8/4.9	3.4/3.6	2.49	0	3.10	100000	1500	100000	6000	500
	0.72	7330	7310	0.28	6990	6970	0.29	5.4/6.4	2.0/3.4	2.48	0.27	2.90	100000	15000	100000	10000	760
	0.42	7350	7320	0.41	7030	7010	0.28	3.8/7.1	2.3/4.0	2.48	0.55	3.50	100000	1070	100000	1150	1020
	0.42	7280	7260	0.27	7050	7020	0.43	5.0/2.8	2.0/3.2	2.47	0.42	3.80	100000	4550	71400	2500	1500
	0.24	7280	7260	0.27	7030	6980	0.71	4.8/6.5	2.2/2.2	2.43	0.42	3.50	62500	3000	27800	3000	2000
Control Limits																	
Average																	
Test By																	

B-21

TYPE

PROCURED BY Acro Products Inc P.O A20065

TESTED PER SPEC MIL-E-1/1121A (PG.1) ___ (PG.2) ___ (PG.3) ___

BRIDGE No. ___

ANT TUBES 20

DATA SHEET

SPECIAL FEATURES Life Test 2000 hrs Part 3 page 8 T.S.S. Ultrasonically Welded Tube Type 6080WB

LOT 60501

PROD. DATE ___

DATE RECEIVED 3-10-66

DATE COMPLETED 5-22-66

Test	I_c	S_m@6.3	S_m@5.7	Δ of S_m	S_m@6.3	S_m@5.7	Δ of S_m	I_{H-K}	I_{H-K}	I_f	$\Delta f S_m$	$\Delta f S_m$	Rg-All	Rg-All	Rg-All	Rg-All		Time of Rem
Rating	Grid Current	Sec 1 Transconductance	Sec 1 Inductance	Sec 1	Sec 2 Transconductance	Sec 2 Coincidence	Sec 2	Heater Leakage	Cathode Leakage	Heater Current	Sec 1	Sec 2	Insulation between Electrodes 1	1 to all of Electrodes 1	Insulation between Electrodes 2	2 to all of Electrodes 2		Life
Commercial Limits	-5 Max	—	—	10% Max.	—	—	10% Max	Sec 1/2 25 Max	Sec. 1/2 25 Max	2.35 2.75	15% Max	15% Max	Sec 1 100 Min	Sec 1 100 Min	Sec 2 100 Min	Sec. 2 100. Min		Hours
Line & Page of Spec																		
Tube No.	4.11.4																	
88	0.50	6860	6840	3.00	6850	6790	0.88	0/0	0/0	2.50	0	0	18500	57700	21700	48400		0
	1.09	6840	6790	0.74	7020	6970	0.72	5.2/4.4	6.0/6.2	2.44	0.30	2.50	100000	30000	100000	25000		100
	1.10	6910	6840	1.00	7010	6980	0.43	8.2/9.8	6.2/5.3	2.44	0.72	2.30	100000	3750	100000	2160		200
	0.72	6880	6840	0.59	7040	7020	0.29	6.8/8.4	4.2/7.0	2.44	0.29	1.30	100000	5550	100000	3340		280
	0.40	6820	6800	0.30	7060	7030.	0.43	9.4/9.8	6.0/5.4	2.44	0.59	3.10	100000	4290.	100000	3000		400
	0.37	6800	6790	0.15	6990.	6980.	0.15	7.4/10.0	4.7/5.1	2.44	0.88	2.00	100000	1870	100000	1500		500
	0.52	6790	6760	0.45	7050	7010	0.57	7.0/8.0	5.7/5.8	2.44	1.00	2.90	100000	3340	100000	3130		760
	0.52	6760	6730	0.44	7120	7070	0.70	3.8/6.8	3.3/4.0	2.44	1.50	3.90	35700	3190	71400	3130		1020
	0.28	6750	6680	1.00	7180	7130	0.70	6.8/5.8	3.0/3.2	2.42	1.60	4.80	8330	500	100000	500		1500
	3.60	6830	6700	1.90	5850.	4950	(15.40)	3.8/3.5	3.5/(30.0)	2.39	0.43	(15.60)	333	—	—	—		2000	K2-G2 SHORT
91	0.50	7000	6860	2.00	7060	6960	1.40	0/0	4.0/4.0	2.50	0	0	14700	25000	23800	31300		0
	0.97	7090	7020	0.99	7040	6980	0.86	3.7/4.2	5.8/3.8	2.42	1.30	0.29	100000	45500	55600	38400		100
	0.98	7150	7080	0.98	7060	7030.	0.43	7.2/7.6	4.4/4.5	2.42	2.10	0	100000	6000	100000	3410		200
	0.58	7130	7090	0.57	7060	7040	0.29	6.0/9.4	2.8/2.4	2.43	1.80	0	100000	6520	100000	4840		280
	0.48	7180	7150	0.42	7080	7060	0.29	6.0/5.8	3.5/4.0	2.43	2.60	0.29	100000	10700	100000	9360		400
	0.36	7120	7110	0.15	7060	7050	0.15	6.4/6.8	2.5/3.5	2.43	1.70	0	100000	3580	100000	2500		500
	0.48	7230	7180	0.70	7130	7090	0.57	6.8/6.2	4.2/4.0	2.42	3.40	0.99	100000	8340	41700	7500		760
	0.38	7200	7180	0.28	7120	7100	0.28	4.2/4.4	2.5/2.2	2.44	2.80	0.85	100000	100000	35700	35000		1020
	0.25	7230	7190	0.55	7190	7150	0.56	10.0/2.9	2.6/3.5	2.43	3.30	1.80	100000	1500	38500	936		1500
	(11.7)	7200	7140	0.83	7160	7100	0.84	9.2/6.8	2.4/2.0	2.42	2.90	1.40	100000	4290	20000	2500		2000	GRID CUT
Control Limits																		
Average																		
Test By																		

B-25

TYPE

REQUESTED BY [illegible] Inc. P.O. A20369

TESTED PER SPEC [illegible] (PG.1) ______ (PG.2) ______ (PG.3) ______

BRIDGE No. ______

AMOUNT TUBES 20

ELECTRON TUBE DIVISION BLOOMFIELD MEASUREMENTS DEPT.

DATA SHEET

SPECIAL FEATURES Life Test 2000 hrs Part 3 page 2 T.S. Ultrasonically Welded Tube Type 6080WB

TYPE 6080

LOT ______

PROD. DATE ______

DATE RECEIVED 3-10-61

DATE COMPLETED 5-22-6[illegible]

Test	Ic	Sm [illegible]	Sm [illegible]	Δ Sm	Sm [illegible]	Sm [illegible]	Δ Sm	Ihk	Ihk	If	Δ Sm	Δ Sm	Rg-All	Rg-All	Rg-All	Rg-All		Life	Remarks
Rating	Grid Current	Sec 1 [illegible]	Sec 1 [illegible]	Sec 1	Sec 2 [illegible]	Sec 2 [illegible]	Sec 2	Heater Leakage	Cathode Leakage	Heater Current	Sec 1	Sec 2	[illegible]	[illegible]	[illegible]	[illegible]		Life	
Commercial Limits	−5 Max μAdc	μmhos	μmhos	10% Max	μmhos	μmhos	10% Max	Sec 1/2 25 Max μAdc	Sec 1/2 25 Max μAdc	2.35 2.75 A	15% Max	15% Max	Sec 1 100 Min Meg Ω	Sec 1 100 Min Meg Ω	Sec 2 100 Min Meg Ω	Sec 2 100 Min Meg Ω		Hours	
Line & Page of Spec.	4.11.4	→																	
Tube No.																			
92	0.70	6950	6940	3.00	7040	6960	1.10	0/0	0/0	2.50	0	0	25000	50000	20000	30000		0	
	1.02	6950	6400	0.72	7170	7080	1.20	2.4/3.0	2.9/1.4	2.44	0	1.80	71400	25000	62500	150000		100	
	1.38	6970	6940	0.44	7120	7070	0.71	2.1/2.8	3.4/3.2	2.46	0.28	1.10	100000	250000	100000	125000		200	
	0.92	6970	6910	0.87	7120	7100	0.29	2.2/4.8	2.4/3.0	2.48	0.28	1.10	100000	216000	100000	107000		280	
	1.82	7020	7000	0.29	7170	7140	0.42	7.4/3.0	3.2/3.2	2.48	1.00	1.80	100000	300000	100000	360000		400	
	2.04	7070	7030	0.57	7190	7160	0.42	6.2/3.0	2.7/2.8	2.47	1.70	2.10	100000	300000	100000	187000		500	
	1.84	7150	7080	0.98	7190	7130	0.84	2.5/2.8	3.0/5.7	2.42	2.90	2.10	100000	250000	100000	216000		760	
	3.70	7170	6980	0.26	7180	6990	0.26	1.9/2.0	5.8/13.8	2.40	3.10	2.00	100000	300000	100000	300000		1020	
	4.80	7310	7110	2.70	7300	7020	3.80	1.5/2.4	12.0/3.2	2.40	5.20	3.70	100000	300000	100000	300000		1500	
	(32.0)	7250	7110	1.10	7170	6880	4.30	2.2/2.4	5.0/(46.0)	2.39	4.30	2.10	100000	150000	100000	167000		2000	Grid C[illegible]
96	0.50	7350	7310	0.55	6300	6270	0.48	0/5.0	3.0/3.0	2.50	0	0	10400	7500	83300	37500		0	
	1.18	7330	7270	1.50	6480	6420	0.93	3.7/4.2	5.3/9.0	2.50	0.40	2.80	71400	40500	62500	55500		100	
	1.05	7350	7320	0.41	6440	6450	0.62	5.1/9.6	4.6/5.6	2.50	0.	3.00	100000	1500	100000	1250		200	
	0.56	7340	7300	0.55	6620	6600	0.31	7.8/3.8	3.1/3.2	2.51	0.14	5.10	100000	750	100000	790		280	
	0.52	7330	7310	0.28	6700	6680	0.30	3.8/6.6	4.0/5.5	2.51	0.28	6.30	100000	3000	100000	3060		400	
	0.38	7350	7330	0.28	6910	6870	0.58	3.1/5.8	3.2/6.2	2.51	0	9.60	100000	790	100000	1360		500	
	0.62	7370	7340	0.41	6960	6900	0.87	5.6/3.5	4.5/5.8	2.50	0.27	10.00	100000	2500	100000	3000		760	
	0.37	7380	7360	0.27	7070	6970	1.40	1.8/3.0	2.2/9.4	2.51	0.40	12.00	2860	326	41700	10700		1020	
	0.20	7400	7300	1.40	6200	5630	9.20	6.8/8.0	3.8/6.5	2.50	0.68	1.60	1110	313	71400	1500		1500	
	0.50	7050	6370	9.60	4710	3960	(16.9)	4.8/6.5	2.8/5.8	2.47	4.10	(24.3)	2940	500	35700	216		2000	High [illegible]
Control Limits																			
Average																			
Test By																			

ELECTRON TUBE DIVISION — BLOOMFIELD MEASUREMENTS DEPT.

TYPE 6080

REQUESTED BY Special Projects Inc. P.O. A-20065

TESTED PER SPEC 11-5-61/12A (PG.1) ____ (PG.2) ____ (PG.3) ____

DATA SHEET

LOT ____

PROD. DATE ____

SERIAL No. ____

DATE RECEIVED 3-10-61

SPECIAL FEATURES Life Test 2000 hrs Weld Part 3 Pages T.S. Ultrasonically Welded Tube Type 6080WB

DATE COMPLETED 5-22-61

ON TEST TUBES 20

Test	Ec	Sec 1 Sec 2 Adj.			Sec 1 Sec 2 Adj.			Trans-conductance	Trans-conductance	If	Δ Sec 1	Δ Sec 2	Rp-All	Rp-All	Rp-All	Rp-All		Time of Read
Read	Grid Current	Sec 1 Ea	Sec 1 Eb	Sec 1	Sec 2 Ea	Sec 2 Eb	Sec 2	Sec 1/2 Range	Sec 1/2 Range	Heater Current	Sec 1	Sec 2	Emission Index Sec 1	Emission Index Sec 2	Emission Index Sec 1	Emission Index Sec 2		Life
Comments Limits	-.5 Max microamps	—	—	10% Max.	—	—	10% Max	Sec 1/2 2.5/sec 1 Adc	Sec 1/2 2.5/sec 2.75 Adc	2.35 2.75 A	15% Max	15% Max	Sec 1 100 Min Meg Ω	Sec 2 100 Min Meg Ω	Sec 1 100 Min Meg Ω	Sec 2 100 Min Meg Ω		Hours
Line & Page of Spec.	11.4															→		
Test No.																		
98	0.60	7120	7020	1.40	7140	7100	0.57	4.0/4.0	3.0/3.0	2.50	0	0	41700	75000	35700	50000		0
	1.25	7140	6990	2.10	7150	7110	0.56	3.4/3.6	5.5/5.7	2.50	0.28	0.14	100000	250000	100000	88300		100
	1.40	7160	7130	0.42	7160	7130	0.42	14.0/9.6	5.2/5.0	2.48	0.56	0.28	100000	10700	100000	3060		200
	0.86	7170	7140	0.42	7180	7160	0.28	8.4/10.4	4.4/3.5	2.50	0.70	0.56	100000	51700	41700	13600		280
	0.82	7170	7120	0.70	7190	7170	0.28	8.2/6.9	4.0/5.0	2.50	0.70	0.70	100000	37500	714	6520		400
	1.10	7120	7110	0.15	7220	7190	0.42	7.0/4.0	3.5/5.8	2.50	0	1.10	100000	10700	625	1870		500
	1.28	7180	7160	0.28	7200	7160	0.56	4.8/3.4	3.0/3.8	2.48	0.84	0.84	100000	5770	7140	714		760
	0.68	7170	7050	1.60	7260	7220	0.55	2.7/3.4	5.4/6.8	2.42	0.70	1.70	100000	18700	1250	2160		1020
	1.10	6650	6280	5.60	7050	6910	2.00	3.0/3.4	2.5/4.2	2.42	6.60	1.30	100000	3340	2940	600		1500
	0.28	5760	5780	10.00	6320	5890	6.80	3.5/3.8	3.8/4.0	2.40	19.10	11.50	100000	300	6250	136		2000 A Sat
99	0.60	7290	7190	1.40	7030	6830	2.80	0/0	0/0	2.50	0	0	17900	40500	21700	40500		0
	0.60	7270	7240	0.42	7050	7000	0.71	1.5/3.2	2.5/3.5	2.44	0.28	0.28	100000	55500	62500	37500		100
	0.62	7280	7220	0.83	7030	6970	0.86	3.0/4.0	2.4/3.8	2.43	0.14	0	100000	8360	100000	6250		200
	0.45	7290	7270	0.28	7080	7030	0.71	2.2/2.8	2.0/2.4	2.44	0	0.71	100000	25000	100000	1500		280
	0.42	7280	7260	0.28	7080	7050	0.43	3.2/3.5	2.5/3.2	2.45	0.14	0.71	100000	18700	100000	7500		400
	0.28	7270	7260	0.42	7110	7080	0.43	2.8/3.4	2.2/3.1	2.45	0.28	1.10	100000	10700	100000	2500		500
	0.64	7280	7240	0.55	6480	6440	0.58	2.2/2.1	1.8/2.8	2.46	0.14	0.72	100000	2500	100000	5360		760
	0.62	7280	7230	0.69	6900	6840	0.87	3.8/2.2	1.5/3.5	2.46	0.14	1.80	100000	21600	2000	5000		1020
	3.50	7280	7250	0.42	6450	6410	0.63	1.8/1.8	2.0/3.5	2.42	0.14	0.83	100000	1000	1350	429		1500
	0.58	7250	7200	0.69	6350	6330	0.31	2.0/5.0	2.5/3.8	2.38	0.55	9.70	100000	150	4550	300		2000
Control Limits																		
Average																		
Test By																		

REQUESTED BY Acrotronics Inc P.O A20069

TEST SPEC MIL-E-1/1121A (PG.1) (PG.2) (PG.3)

P No.

NT TUBES 20

DATA SHEET

SPECIAL FEATURES Life Test 2000 hrs, Part 3 Page 8 T.S.
Ultrasonically Welded Tube Type 6080WB

LOT 10C901

PROD. DATE

DATE RECEIVED 3-10-61

DATE COMPLETED 5-22-61

Test	I_c	$S_{m\ Sec\ 1}$	$S_{m\ Sec\ 1}$	Δ of S_m	$S_{m\ Sec\ 2}$	$S_{m\ Sec\ 2}$	Δ of S_m	I_{H-K}	I_{H-K}	I_f	Δf_{Sm}	Δf_{Sm}	Rg-All	Rg-All	Rg-All	Rg-All	Time of	Remarks
Rating	Grid Current	Sec 1 Transconductance	Sec 1 Conductance	Sec 1	Sec 2 Transconductance	Sec 2 Conductance	Sec 2	Heater to Cathode Leakage	Heater to Cathode Leakage	Heater Current	Sec 1	Sec 2	Insulation between Electrodes Sec 1	Insulation between Electrodes Sec 1	Insulation between Electrodes Sec 2	Insulation between Electrodes Sec 2	Life	
Commercial / Limits	-5 Max µAdc	— µAdc	— µAdc	10% Max.	— µmhos	— µmhos	10% Max	Sec 1/2 25 Max µAdc	Sec 1/2 25 Max µAdc	2.35 2.75 A	15% Max	15% Max	100 Min MegΩ	100 Min MegΩ	100 Min MegΩ	100 Min MegΩ	Hours	
Line & Page of Spec.	4 11.4															→		
Tube No.																		
100	0.50	7270	7210	0.83	7220	7160	0.84	0/0	4.0/3.0	2.50	0	0	23800	31300	11100	13600	0	
	1.14	7220	7180	0.56	7180	7140	0.56	8.0/9.2	3.8/3.4	2.46	0.69	0.56	100000	55500	100000	45500	100	
	1.32	7290	7270	0.28	7200	7150	0.70	10.4/8.0	5.0/4.7	2.48	0.27	0.28	100000	4410	100000	1500	200	
	0.72	7320	7290	0.41	7220	7190	0.42	9.4/9.2	2.5/4.8	2.46	0.68	0	100000	6250	100000	3060	280	
	0.54	7320	7280	0.43	7210	7180	0.42	8.6/5.6	3.8/3.4	2.46	0.68	0.14	100000	3000	100000	2160	400	
	0.49	7310	7240	0.96	7260	7220	0.56	8.4/4.6	3.4/2.8	2.46	0.55	0.55	100000	2160	71400	1360	500	
	0.60	7280	7140	1.90	7180	7140	0.56	4.6/3.2	2.8/2.6	2.47	0.13	0.28	100000	750	2940	3000	760	
	0.43	7270	7140	1.80	7180	7150	0.42	5.2/4.2	3.8/6.0	2.47	0.13	0.28	100000	2160	5560	6520	1020	
	0.32	(6430)	5780	(10.1)	7030	6880	2.10	4.8/4.0	2.0/2.8	2.40	11.60	2.60	100000	1250	10000	1500	1500	Low Sm Sect. 1
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2000	K2-G2 SOLID SHI
101	0.90	7070	6710	5.10	6850	6750	1.50	0/0	0/0	2.50	0	0	10000	150000	50000	79000	0	
	0.64	7270	7230	0.56	7020	6850	2.40	2.2/1.5	5.0/0.8	2.35	2.80	2.50	100000	88300	100000	167000	100	
	0.50	7270	7230	0.56	6970	6860	1.60	8.0/6.2	4.2/4.8	2.47	2.80	1.60	100000	75000	100000	35300	200	
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	280	INTER-MITTENT OPEN
																	400	
																	500	HEATE
																	760	
																	1020	
																	1500	
																	2000	

B-28

TYPE

RE... TED BY Aerojet-Gen Corp P.O. A20065

TES... D PER SPEC MIL-E-1/1121A (PG.1) (PG.2) (PG.3)

DATA SHEET

LOT ...

PROD. DATE ...

BRIDGE No. ...

AMOUNT TUBES 20

SPECIAL FEATURES Life Test 2000 hrs, Part 3 pages T.S.J. Ultrasonically Welded Tube Type 6080WB

DATE RECEIVED 3-10-61

DATE COMPLETED 5-22-61

Test	Ic	Sm@6.3	Sm@5.7	Δ of Sm	Sm@6.3	Sm@5.7	Δ of Sm	I H-K	IH-K	If	Δ of Sm	Δ of Sm	Rg-All	Rg-Al	Rg-All	Rg-All	Time of	Remarks
Rating	Grid Current	Sec 1 Transconductance	Sec 1 Transconductance	Sec 1	Sec 2 Transconductance	Sec 2 Transconductance	Sec 2	Heater to Cathode Leakage	Heater to Cathode Leakage	Heater Current	Sec 1	Sec 2	Insulation by Electrodes	Insulation by Electrodes	Insulation of Electrodes	Insulation of Electrodes	Life	
Commercial 6080A Limits	-5 Max μAdc	— μmhos	— μmhos	10% Max.	— μmhos	— μmhos	10% Max	Sec 1/2 25 Max μAdc	Sec. 1/2 25 Max μAdc	2.35 2.75 A	15% Max	15% Max	Sec 1 100 Min MegΩ	Sec 1 100 Min MegΩ	Sec. 2 100 Min MegΩ	Sec. 2 100 Min MegΩ	Hours	
Line & Page of Spec	4 11.4																	
Tube No.																		
104	1.00	7290	7250	0.55	7020	7000	0.29	0/0	0/0	2.50	0	0	45500	83400	83300	25000	0	
	1.02	7320	7280	0.55	7060	7020	0.57	8.5/1.8	3.0/4.2	2.48	0.41	0.56	71400	115000	55600	35800	100	
	1.10	7320	7290	0.41	7050	7010	0.57	4.0/7.2	4.2/5.0	2.49	0.41	0.42	100000	9360	100000	13600	200	
	0.84	6640	6650	0.60	7040	7050	0.57	7.4/6.8	4.8/5.0	2.48	8.20	0.99	100000	15000	100000	30000	280	
	0.54	7310	7290	0.28	7100	7080	0.29	5.6/1.8	4.2/4.4	2.49	0.27	0.28	100000	30000	100000	30000	400	
	0.41	7300	7270	0.42	7110	7100	0.15	4.8/5.5	4.4/4.2	2.49	0.15	1.30	100000	7500	100000	5770	500	
	0.58	7280	7250	0.42	7070	7040	0.43	4.2/3.2	2.2/2.5	2.49	0.13	0.71	100000	13600	100000	25000	760	
	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	1020	INTERMIT
																	1500	OPEN HEATE
																	2000	
106	0.50	7020	6920	1.40	6930	6900	0.44	0/0	0/0	2.30	0	0	35700	68200	33300	65200	0	
	0.74	7050	7010	0.57	7000	6950	0.72	4.0/5.2	2.0/2.5	2.40	0.42	1.00	100000	60000	100000	75000	100	
	0.82	7080	7050	0.57	6980	6950	0.43	4.8/3.6	3.7/3.3	2.40	0.85	0.72	100000	6250	100000	4640	200	
	0.54	7130	7100	0.43	7000	6970	0.43	4.2/5.6	3.0/3.4	2.42	1.60	1.00	100000	31300	100000	6820	280	
	0.42	7140	7090	0.71	7030	6970	0.86	3.4/3.2	2.8/2.8	2.40	1.70	1.40	100000	30600	100000	3060	400	
	0.40	7170	7130	0.56	7080	7050	0.43	2.5/3.0	2.6/2.5	2.41	2.10	2.20	100000	21300	100000	4680.	500	
	0.64	7160	7120	0.56	7050	7030	0.29	3.0/3.3	2.0/2.1	2.42	2.00	1.70	100000	290	100000	625.	760	
	0.45	7210	7140	0.97	7040	7010	0.43	2.4/2.4	2.6/2.0	2.42	2.70	1.60	50000	3130	20900	750.	1020	
	0.82	7200	7160	0.56	7030.	7000.	0.43	2.0/1.8	1.5/1.3	2.40	2.60	1.40	100000	4290	100000	3750.	1500	
	0.24	7160	7130	0.42	6960.	6940	0.29	2.7/2.5	1.8/2.0	2.37	2.00	0.43	33300	167.	16700	150	2000	
Control Limits																		
Average																		
Test By																		

B-29

TYPE

REQUESTED BY Accel Projects Inc P.O A20069

TESTED PER SPEC MIL-E-1/1121A (PG.1) ___ (PG.2) ___ (PG.3) ___

BRIDGE No. ___

AMOUNT TUBES 20

DATA SHEET

SPECIAL FEATURES Life Test 2000 hrs, Part 3 Page 2 T.S.
Ultrasonically Welded Tube Type 6080WB

160901

LOT ___

PROD. DATE ___

DATE RECEIVED 3-10-66

DATE COMPLETED 5-22-66

Test	I_c	S_{m2} 6.3	S_{m2} 6.3	Δ of S_m	S_{m2} 6.3	S_{m2} 6.3	Δ of S_m	I_{H-K}	I_{H-K}	I_f	$\Delta f S_m$	$\Delta f S_m$	Rg-All	Rg-Al	Rg-All	Rg-Al	Time of Rem
Rating	Grid Current	Sec 1 Transconductance	Sec 1 Transconductance	Sec 1	Sec 2 Transconductance	Sec 2 Transconductance	Sec 2	Heater to Cathode Leakage	Heater to Cathode Leakage	Heater Current	Sec 1	Sec 2	Insulation by of Electrodes	Insulation by of Electrodes	Insulation by of Electrodes	Insulation by of Electrodes	Life
Commercial Limits	-5 Max	—	—	10% Max.	—	—	10% Max	Sec 1/2 25 Max	Sec. 1/2 25 Max	2.35 2.75	15% Max	15% Max	Sec 1 100 Min	Sec 1 100 Min	Sec 2 100 Min	Sec 2 100 Min	Hours
Line & Page of Spec.																	
Tube No.	4.11.4																
107	0.70	7300	7220	1.10	7050	6920	1.80	0/0	0/4.0	2.50	0	0	17900	40500	10000	21600	0
	1.30	7310	7270	0.55	7070	7020	0.71	7.1/7.0	2.9/2.8	2.43	0.13	0.28	100000	30600	100000	42900	100
	1.35	7310	7280	0.42	7000	6960	0.58	6.8/5.2	3.7/4.0	2.42	0.13	0.71	100000	5000	100000	8830	200
	0.72	7350	7310	0.55	6990	6940	0.72	2.8/3.8	2.6/3.0	2.42	0.68	0.86	100000	11500	100000	3130	260
	0.58	7340	7300	0.55	7080	7060	0.29	4.2/2.8	2.8/3.8	2.44	0.54	0.42	100000	10000	100000	31300	400
	0.55	7340	7310	0.41	7140	7100	0.57	4.4/3.8	2.2/2.8	2.43	0.54	1.20	100000	16700	100000	21600	500
	0.60	7320	7290	0.41	7090	7050	0.57	2.4/2.5	2.4/0.5	2.42	0.77	0.56	100000	1670	100000	3000	760
	0.40	7380	7280	1.40	7060	7040	0.28	3.2/3.0	1.2/3.2	2.43	1.10	0.14	21700	1670	23800	3000	1020
	0.30	7350	7310	0.55	7250	7220	0.42	4.1/3.8	2.2/2.2	2.43	0.68	2.80	62500	714	100000	1500*	1500
	0.25	7310	7280	0.41	7250	7210	0.55	4.5/3.8	2.1/1.9	2.41	0.14	2.80	11600	50000	83300	4690	2000
108	0.80	7070	6920	2.10	7000	6940	0.86	0/0	4.0/0	2.50	0	0	22700	50000	35700	62500	0
	0.95	7080	7040	0.57	6960	6920	0.58	7.0/2.1	3.0/2.9	2.50	0.14	0.58	100000	68200	100000	54600	100
	1.10	7330	7270	0.82	7000	6960	0.50	7.5/3.8	3.5/5.2	2.49	3.70	0	100000	15000	100000	12500	200
	0.64	7060	7040	0.29	7040	7010	0.43	4.4/6.4	3.0/2.9	2.50	0.15	0.57	100000	30300	33300	13600	280
	0.49	7040	7010	0.43	7090	7060	0.43	7.0/5.4	3.8/4.4	2.51	0.43	1.30	100000	11500	71400	8830	400
	0.50	7080	7060	0.27	7070	7060	0.15	6.2/3.9	4.0/3.7	2.50	0.14	1.00	1000	3190	4550	8830	500
	0.48	7170	7140	0.42	7160	7140	0.14	4.4/2.7	8.4/3.8	2.49	1.40	2.40	27800	55500	33300	36600	760
	0.38	7150	7130	0.28	7170	7140	0.42	4.2/4.5	3.0/2.9	2.43	1.10	2.40	625	3340	417	3190	1020
	0.20	7140	7120	0.29	7230	7190	0.56	4.0/4.0	2.7/1.4	2.40	0.99	3.30	1060	600	100000	883	1500
	0.18	7190	7150	0.56	7200	7170	0.42	3.5/1.8	4.0/3.9	2.40	1.70	2.90	3570	4170	834	455	2000
Control Limits																	
Average																	
Test By																	

B-30

TYPE

ELECTRON TUBE DIVISION — BLOOMFIELD MEASUREMENTS DEPT.

REQUESTED BY Aeroprobe Inc A 20069 — LOT

TESTED PER SPEC MIL-E-1/1121A (PG.1) (PG.2) (PG.3) — PROD. DATE

BRIDGE No. — DATE RECEIVED 3-11-66

AMOUNT TUBES 15 — SPECIAL FEATURES Survival Life Test Ultrasonically Welded Gold Bow (100 hrs) 4.11.9.1b — DATE COMPLETED 3-15-66

DATA SHEET

Stability & 4.11.3.1a

Test	I_{b_1}	I_{b_2}	I_c	I_f	S_{m_1}	S_{m_2}	I_{Hk+}	I_{Hk-}	Shock	S_{m_1}	S_{m_2}	$\Delta t S_m$	$\Delta t S_m$	S_{m_1}	S_{m_2}
Rating	Plate	Current	Grid Current	Heater Current	Transconductance		Heater Leakage	Cathode Leakage	#Cont.	Transconductance		Change in Transconductance		Sec 1 Transconductance	Sec 2 Transconductance
Commercial Limits	100 Min. 150 Max. mAdc	Min. Max. mAdc	-1.0 Max. μAdc	2.35 2.65 A	6000 8200 μmhos	Min. Max. μmhos	Sec. 1/2 25 Max μAdc	Sec 1/2 25 Max μAdc	nutty	5800 Min μmhos		Sec 1 10 Max %	Sec 2 10 Max %	—	—
Line & Page of Spec.	4.10.4	4.10.4.1	4.10.6.1	4.10.8	4.10.9	4.10.9	4.10.15	4.10.15	4.7.5	Para 3 Page 4 4.11.4		Para 3 Page 3 4.11.4	Para 3 Page 3	4.10.9	4.10.
Tube No.	Pre Survival Rate Life Test Data & Stability									Post Survival Life Test Data		Post Stability Life Test Da			
1 16	110	108	0.5	2.5	7060	6270	6/7	17/20	0.1K	7300	7100	1.70	5.10	7290	659
2 25	107	115	0.3	2.6	6980	6850	5/5	8/0	0.1K	7090	7260	0.57	3.80	6940	7110
3 27	106	113	0.4	2.6	6680	7250	3/3	5/5	0.1K	7140	7350	2.04	0.55	6550	721
4 28	107	112	0.3	2.6	6640	6880	6/8	18/14	0.1K	6860	7020	0.45	2.18	6610	703
5 29	112	110	0.5	2.6	6830	6580	5/5	15/15	0.1K	7050	7210	2.05	4.41	6970	687
6 32	107	110	0.4	2.6	6670	6690	3/4	8/10	0.1K	7200	7160	2.70	1.35	6850	6780
7 36	107	113	0.6	2.6	7000	7120	4/4	7/5	0.1K	7240	7400	1.43	1.83	7100	7250
8 39	112	103	0.7	2.6	7240	6950	4/4	5/5	0.1K	7220	7090	0.14	3.88	7250	720
9 40	112	112	0.5	2.6	7000	7220	3/3	5/4	0.1K	7110	7270	0.72	0.83	7050	716
10 168	115	115	0.8	2.5	7340	6840	0/0	0/0	0.1K	7300	6830	0.14	2.92	7350	6860
11 169	115	120	0.3	2.5	7150	7110	3/3	0/0	0.1K	7180	7110	1.11	0.56	7230	7150
12 181	110	110	0.5	2.5	6950	6850	5/5	3/3	0.1K	7020	7010	0.00	1.46	6950	6950
13 182	115	115	0.4	2.5	6780	6750	0/0	0/0	0.1K	6820	6850	0.59	0.29	6820	6770
14 184	110	120	1.0	2.5	7090	6460	6/8	0/0	0.1K	7180	6500	0.42	1.08	7120	653
15 185	110	115	0.9	2.5	7150	7260	5/5	9/6	0.1K	7260	7300	0.70	0.27	7200	728
16															
17															
18	Note ① Tube No's 16 thru 40 & 185 have Sec 1 Cathode connection inter changed with Sect. 2														
19	② All tubes meet Stability & Survival Life Test End points														
20															

Test witnessed by U.S.A.F. Comm
Production Engineer

M. Yamamoto 4-12-66

Control Limits															
Average															
Test By															

TYPE

ELECTRON TUBE DIVISION — BLOOMFIELD MEASUREMENTS DEPT.

REQUESTED BY Arco Projects Inc. P.O A20069 — 16080 W15

TESTED PER SPEC MIL-E-1/1214A (PG.1) (PG.2) (PG.3)

DATA SHEET, Electrical Tests
Acceptance Inspection Parts 1 & 2 of T.S.S.

BRIDGE No.

AMOUNT TUBES 10

SPECIAL FEATURES Ultrasonically Welded Tubes Bofors

LOT

PROD. DATE

DATE RECEIVED

DATE COMPLETED 3-9-66

Test	I_{b1}	I_{b2}	I_c	S_{m1}	S_{m2}	I_{HK+}	I_{HK-}	Heater Cont.	I_f	R_{sec1}	R_{sec1}	R_{sec1}	R_{sec2}	Low	I_{b21}	I_{b22}	ΔS_{m1}	ΔS_{m2}	M_{u1}	M_{u2}
Rating	Plate Current		Grid Current	Transconductance		Heater-Cathode Leakage		—	Heater Current	G-A11	G-A11	P-A11	P-A11	Pressure	Plate	Current (2)	Ef	Ef	Amplif.	
Commercial Limits	100 Min 150 Max	mAdc mAdc	-1.0 Max.	6000 8200	Min. Max	Sec 1/2 25 Max.	Sec. 1/2 25 Max.	—	2.35 2.65	200 Min.	200 Min.	200 Min.	200 Min.	500 Min.	10 Max.	10 Max	10% Max.	10% Max.	2.5 Max.	2.5 Max.
	mAdc	mAdc	μAdc	μmhos	μmhos	μAdc	μAdc		A	MegΩ	MegΩ	MegΩ	MegΩ	Vdc	mAdc	mAdc	%	%	—	—
Line & Page of Spec.	4.10.4.1	4.10.4.1	4.10.6.1	4.10.9	4.10.9	4.10.15	4.10.15	4.7.5	4.10.8	4.8	4.8	4.8	4.8	4.9.12.1	4.10.4.1	4.10.4.1	4.10.9	4.10.9	4.10.11.1	4.10.1
Tube No.																				
156	114	114	0.4	7230	6600	4/4	4/4	0.1K	2.5	20000	20900	25000	4290	0.1K	0.1	2.9	0.97	0.94	2.15	2.0
157	121	120.5	0.1	6810	6720	0/0	0/0	0.1K	2.4	25000	13500	25000	10000	0.1K	2.8	4.7	0.29	0.45	1.96	1.9
158	111	109	0.8	7170	6650	0/0	0/0	0.1K	2.5	12500	5000	30000	13600	0.1K	0.1	0.0	1.95	5.85	2.22	2.2
159	113	111	0.8	7350	6950	4/4	5/5	0.1K	2.5	13900	7140	107000	12500	0.1K	0.0	0.0	0.68	1.73	2.19	2.15
160	117	111	1.0	7090	7300	0/0	0/0	0.1K	2.5	12500	20000	15000	15000	0.1K	0.0	0.0	0.99	0.68	2.01	2.17
161	110	110	0.6	6830	7180	4/4	5/5	0.1K	2.4	7140	83300	18700	18700	0.1K	0.0	0.0	0.12	1.40	2.19	2.19
162	113	111.5	0.5	7110	6960	5/5	4/4	0.1K	2.5	12800	6250	3750	3410	0.1K	0.0	0.0	0.51	1.43	2.21	2.13
164	124	112	0.8	6740	7010	0/0	0/0	0.1K	2.6	10600	4170	25000	11500	0.1K	2.7	0.4	0.96	1.71	1.92	2.10
166	118	119	0.5	7200	6560	0/0	5/5	0.1K	2.5	55600	11100	25000	8340	0.1K	0.5	3.5	0.55	0.91	2.04	1.92
167	117	112	0.6	7300	6930	0/0	0/0	0.1K	2.5	6250	7140	13600	12500	0.1K	0.0	0.2	0.68	3.03	2.11	2.14
2																				
3																				
4																				
5																				
6																				
7																				
8																				
9																				
10																				
Control Limits																				
Average																				
Test By																				

Tests Witnessed by USAE Com.
Production Engineer

M. Yannarelly 4-12-66

Sheet 1 of 2

TYPE

864 4B

ELECTRON TUBE DIVISION — BLOOMFIELD MEASUREMENTS DEPT.

REQUESTED BY Aeroprojects Inc P.O A 20069

TESTED PER SPEC MIL-E 1/1121A (PG.1) (PG.2) (PG.3)

BRIDGE No.

AMOUNT TUBES

DATA SHEET Electrical Tests (cont.)

Acceptance Inspection tests Parts 1 & 2 of T.S.S.

SPECIAL FEATURES Ultrasonically Welded Tubes Type 6080WB

LOT

PROD. DATE

DATE RECEIVED

DATE COMPLETED 3-9-64

Test	ΔIb	Eb	Ep	Eg
Rating	Plate Current	V.b (2)	V.b (2)	V.b (2)
Commercial Limits	Diff. 25 Max. mAdc	X Pos. 500 Max. mVac	Y Pos. 500 Max mVac	Z. Pos 500 Max mVac
Line & Page of Spec.	Part 2 Page 2	Part 2 Page 2	Part 2 Page 2	Part 2 Page 2
Tube No.				
1 156	0.0	130	(600)	40
2 157	0.5	100	80	25
3 158	2.0	130	90	50
4 159	2.0	130	80	100
5 160	6.0	120	100	45
6 161	0.0	100	65	20
7 162	1.5	210	180	60
8 164	12.0	150	150	110
9 166	1.0	250	270	90
10 167	5.0	170	220	110
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
Control Limits	Note Tube No 156 out of Test limits Vib.(2) YPos.			
Average				
Test By				

864 4B

TYPE

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